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ELECTRICAL WORLD AND ENGINEER.

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THE STREET RAILWAY CONVENTION.

It will have been noted from the report which we gave in our issue last week of the Detroit Street Railway Convention, and by the supplementary details presented in this week's issue, that the association did not take up this year with as much fullness and specific attention the engineering questions relative to the great art of urban traction. This, of course, must have been more by way of deliberate plan than accidental, as there are many engineers of the highest standing who would welcome the opportunity to appear before such an influential body and to discuss standard features or to ventilate their own ideas as to the manner in which new conditions should be met. The availability of such matter and the general interest in it were well evidenced by the Great Barrington meeting of the American Institute of Electrical Engineers last June, and we think that many members of the Street Railway Association will have regretted this absence of discussion on technical subjects. It is, however, a moot question how far such a body as the Street Railway Association should go in technical discussions, and whether it is not better to take up the broad issues of general policy relating to the care of traffic, the handling of employees and other matters which have nothing to do with the construction and care of apparatus. The meeting, last May, of the National Electric Light Association went pretty far in technical controversies, and brought up a multitude of engineering topics, but after all, many of these might have been better left to the Institute, freeing the association to consider—as it never yet has properly considered—the great questions of dealing with the public. The deep interest shown in the vital and ever present question of rates was an indication of the manner in which the practical, managerial members desire to thresh out matters which deal with the dividend earning capacity of the properties entrusted to them.

The Street Railway Association had already undergone a process of subdivision in the creation of the Accountants Association, to take care of the more specific technical questions belonging to the financial end of the business; and a further excellent step was taken last week in the proposal to organize an association of master mechanics of the different street railway companies. This, again, tends to deprive the programme of many interesting papers, and leaves the discussion of them to men more particularly concerned, so that the great central body will have more time than ever to take up the large problems of administration, which belong in the hands of the executive heads rather than in those of the technical staff. Presumably this division of work was in mind in drawing up the programme of the meeting last week, and we are rather curious to see how it works out in later conventions. In view of the fact, however, that the body of master mechanics was not yet in existence, we think the programme might well have been enriched by one or two papers such as they would deal with. For it must be evident to any one who studies the situation that at this stage as much as at any other, the engineering aspects of the art are fresh and new, and invite to that friendly discussion which can best be indulged in at such gatherings.

Elsewhere, we discuss the treatment of the steam turbine at the convention, and, having done that, exhaust the large technical questions brought before the body. One other paper which was of wide general interest was that of Mr. G. W. Parker, of the Detroit United Railway, on "Electric Express and Package Delivery." As noted

in our columns last week, this paper was extremely interesting, but it is agreed by all who attended the convention, that only by visiting the territory in which the company operates can a full scope of the magnitude of this work be realized. So far as the farmer is concerned, the trolley has deprived the word "isolation" of any meaning. It has been said that farmers' wives have been more apt to become weak-minded because of the loneliness of their lives than any other class in the community. But any one who thinks that a farmer's life need be lonely has only to visit the rural regions lying around Detroit. There, every farmer who chooses has his telephone. There, it is hard to find a farm house which is out of sight or out of sound of the ubiquitous trolley. There, the main trolley lines follow stragetic routes for the collection of farm produce, while switches and sidings ramify ell nigh to every farmer's barn door. The city storekeeper can make swift and easy delivery to his bucolic customers, while from every hill and valley a constant stream of farm freight converges towards the freight depots of the trolley system, either for city supply or for transfer to the steam railroads. It is impossible not to be profoundly impressed with the possible range of such work; it is impossible not to be convinced of its great benefit and utility to the farming population.

THE STEAM TURBINE.

The paper which, judging from the animated discussion which followed its reading, elicited the greatest interest at the Detroit Street Railway Convention, was one on the steam turbine, an abstract of which is printed elsewhere in this issue. While the paper is frankly a commercial one and refers to but one type of turbine, it is of much general interest through setting forth in detail the advantages claimed for this prime mover as applied to the generation of electric current. While perhaps not of so much practical moment at the present day as some others of its features, the high speed of the turbine is an ideal qualification if the fundamental principles of electric generation are alone considered. Indeed, had the steam turbine been perfected in the early days of electrical engineering, no thought would probably have been given to any other type of engine, and dynamo development would have proceeded along quite different lines. As it was, engineering ability was concentrated on bringing up the speed and regulation of the reciprocating engine, lowering the speed of the electrical generator, and otherwise co-ordinating the two. The result merits one of the finest pages in the story of engineering triumphs, for the combination has been adapted to meet with commercial success every application in current generation thus far developed. Though for parallel operation the steam turbine appears to be better adapte than the reciprocating engine, the latter is far from being disqualified on this score in practical operation; and the slow-speed generator has been brought to a point of efficiency that leaves little or no margin for improvement—and superior electrical efficiency could not reasonably be expected at the higher speeds of the turbine generator.

The matter thus practically resolves itself into one of steam economy and first cost, if we leave aside the question of practical operation of turbine units, concerning which there is at present little data. While the paper does not touch on the cost of the prime mover itself, it dwells upon the installation factors entering into the total cost of a plant; it is shown that these in every particular are lower than in the case of a plant using reciprocating engines, either vertical or horizontal, while the cost of the turbine dynamo is also much smaller than a low-speed machine of same capacity. Accepting the figures given, it thus appears that whether the turbine unit as installed will be cheaper than a corresponding reciprocating engine unit depends upon the cost of the turbine itself, and no direct information was given on this point. In the discussion, however, it was stated that the turbine to which the paper particularly referred would not be sold separately from the electrical machine, but that the total cost installed of the complete unit is such as to compare favorably with the cost of a corresponding unit of the present type. Should the policy thus implied of considering the steam and electrical parts of generating apparatus, as one unit in manufacture, be fruitful of good results, we may look forward to a general and wide departure from present manufacturing methods, one of the first consequences of which will probably be the entry of engine builders into the dynamo field. As to economy, a number of authoritative tests show a remarkably low steam consumption for the turbine—in some cases below 11 pounds per indicated horse-power under conditions not at all ideal. Even the best friends of the steam turbine do not claim that it has reached a final state of development, and there is strong probability that considerably higher efficiencies will be attained, particularly owing to the adaptabi'ity of the steam turbine to the use of superheated steam at temperatures entirely beyond the range of the reciprocating engine. The case made out for the steam turbine unit by its advocates is one of strength, and all interested in electrical generation will look forward with the keenest expectancy for the verdict which practical experience over a sufficient length of time will bring forth.

THE CALCULATION OF DYNAMO ARMATURES.

A rescript of a paper recently presented by Prof. Pasqualini to the Italian Electrotechnic Association, appears on page 614. It discusses the question of the design of dynamos by a series of formulæ. If the plan were feasible, and were carried out, dynamos would be built by the book, and for any particular type of winding, the detailed electric and magnetic properties of a dynamo would be capable of tabulation in advance, like the sun's daily position in the nautical almanac of the coming year. At the present time, as is well known, there is no fixed basis of calculation for dynamo design. Even if the speed of rotation of a given size of machine is fixed, there may be an indefinitely large number of variations in dimensions, which will fill the remaining specifications. For example, the iron in the machine may be plentiful, and the number of armature conductors few, or *vice versa*. There is no rule for blindly predetermining the armature and field-magnet dimensions accompanying a given speed of rotation and kilowatt-output. Various co-ordinate iron structures of field and armature might be found leading to a possible solution.

There is a corresponding divergence of opinion and habit among different designers and manufacturers of dynamos. Some affect one type and set of dimensions, while others lean to a different type and set. In the main, however, dynamo designers usually make their machines about the same size and weight for a given output and given speed; but this consensus of action is governed by a variety of circumstances, among which economy of construction, based on the ruling prices of iron, of copper and of labor, play the dominant rôle. If the relative prices of iron, copper and labor were to change materially and suddenly, within a year we might look for a modification in the type and dimensions of dynamos for a given output and speed, tending to restore the minimum cost of construction consistent with filling commercial requirements.

Prof. Pasqualini has, however, attacked the problem on the basis of an initial criterion. He designs for a minimum volume of iron in the armature, with a view to reducing the loss by hysteresis to a minimum during the operation of the machine, and thus aiming at

a maximum efficiency. We doubt, however, whether the proposition is true that the minimum volume of iron in an armature involves minimum hysteretic loss, other things being equal. On the contrary, it would seem that this proposition is invalid; since reducing the dimensions at fixed flux density might reduce hysteresis, but reducing dimensions at varied flux density might be yet better. At all events, demonstration seems to be needed to show that the fundamental proposition is true, and that a machine with minimum armature iron is the most efficient machine, other things being equal.

Even if the proposition were true, we believe that it could not be trusted to produce a commercially satisfactory machine. There are so many considerations involved in the design of a dynamo, that the final design is a mere compromise, like the vote of a much divided caucus. It is probable that an experienced dynamo designer could work out, in nearly every instance, a better dynamo than the one turned out by the Pasqualini formulas. But it would be arrived at by dint of much empirical variation of design and the survival of the fittest. The only thing that can be said for the Pasqualini method is that it strikes at a single definite solution of the problem for a definite purpose. If the formulæ are correct, the dynamo they determine will have about the minimum revolving iron in it that the conditions assigned will permit. There is at least comfort in this; but whether any hard and fast rule for determining in advance the dimensions of this dynamo of minimum armature core would be as good as some other type of machine is quite another proposition. In spite of the precision of electrical measurements and the accuracy of machine predetermination, it seems safe to predict that there never will be a dynamo built by formula without compromise.

Problems of Inter-Atomic Physics.

The investigations of the last three or four years have raised a great many curious questions touching the constitution of matter and the nature of electrical phenomena. The group of occult radiations, of which the Röntgen ray was the pioneer, have gradually been linked to a species of sub-atomic theory which seems to be assuming far reaching importance. The hypothesis of charged corpuscles certainly enables one to clear up a good many difficulties and raises at the same time a host of curious questions. Of course, the whole matter is yet in a tentative state; a vast deal of pioneering along the line has been done, but the results have not been by any means fully co-ordinated. Once granted that the atom is by no means worthy of its name and we acquire a flexibility in the constitution of things that is well nigh certain to lead to important results. Whatever the facts of the corpuscular case may ultimately prove to be, it must be remembered that the atom has been under grave suspicion for a quarter of a century. No one who is familiar with the recent progress of spectroscopy relating to the correlation between the spectra of cognate elements has been able to retain the corfortable point of view assumed by the chemist. There has long been reason to believe that atoms of similar elements are possessed of certain dynamically similar constituents, and all this recent work points to giving the atom a microcosmic character entirely in keeping with these older facts. Once this is granted, there is no logical reason why the atom should not evaporate corpuscles from its surface, possess properties homologous with vapor tension in masses, and much more to the same effect. Certainly the sacred inviolability of the atom has long since lost its grip, and recent developments can hardly be called inconoclastic.

But with all this, the phenomena charged up to corpuscular action need very careful investigation, and while they may in terms explain a great many things, they are themselves woefully in need of explanation. They are very far as yet from throwing much light on electrical phenomena as such. There is very little comfort to be derived from postulating electric charges on corpuscles unless one is prepared to state what he means by electrical charge. There is great need of turning the searchlight of investigation on the dynamics of electrification in order to make clear the meaning of its presence on either atoms or corpuscles. Otherwise one commits the same logical error of which the old astronomers were guilty in invoking a new epicycle every time they found a new irregularity in a planetary orbit. To put the matter even more plainly, note that an electrical wave propagated with a known velocity sets up a species of strain which has long been associated with the term electrification. Now it may concurrently set up enormous corpuscular activity in the body affected, but we must take care not to confuse the effect with the cause, and the final question remains the same—corpuscles or no corpuscles—what is the nature of the energy transference? We do not in the least get away from the difficulty by shuffling it off on the already heavily burdened corpuscles. And as to these latter, we are in a bad way unless some means can be found of attacking the very puzzling problems they raise along other than electrical lines. There would seem to be danger of arguing in a circle unless some independent means of investigation can be found. The whole subject is befogged for lack of such means. For example, we have now had the Röntgen ray in view and in use for some years, and wonderfully little is known about it that was not in the beginning set forth in Röntgen's great original paper.

If one stops to think of it, the available means of investigation in the study of occult radiations and their allied phenomena are singularly meagre. Aside from the electrometer, which is somewhat indirect and limited in its powers, although wonderfully sensitive in certain cases, we have little but photography upon which to rely. And, if one stops to think of it, photography as we now know it practically depends wholly upon the sensitiveness of the haloid salts of a single element—silver—to certain kinds of radiation. And in the presence of the beautiful variety of radiations that are now showing up, the wonder is that photography is of any use at all. On general principles, there should be chemical compounds sensitive to radiations, in the presence of which the silver salts are stable; and if such could be found our grasp on the Röntgen rays and their kindred should be wonderfully strengthened. A systematic search ought to be undertaken for radiation-sensitive compounds. Not only would a find in this line be of great value to the investigator, but it might also prove to be a priceless addition to scientific photography. The chemical resources of the art, even to-day, are not greatly beyond what was known half a century ago. Abney, to be sure, got an allotropic form of silver bromide somewhat sensitive to infrared radiations, but that is about the end of the story. Among the compounds of elements of high atomic weight there is good reason to expect new resources for the study of the general range of radient energy and the emanations which have recently been annexed to it. Here is a task worthy the most persistent efforts of the chemist and physicist. At present investigators are blundering around with facilities entirely inadequate to the work they are undertaking, and progress is almost of necessity slow and difficult. The chemical side of the problem has thus far been somewhat neglected; in fact, the whole subject of inorganic chemistry has in recent times fallen into neglect. There is sad need of some genius to do for general chemistry what Kekulé and his followers did for the chemistry of carbon compounds. Mendelief's work marks the way, but thus far there have been few to follow it. The resources of the electrician have thrown a little light into the darkness, but more methods of attack are needed before the present problems can be solved.

The Annual Report of Western Union.

The annual report of the Western Union Telegraph Company for the year ended June 30, 1902, was issued last week. The income account compares as follows:

	1902.	1901.	Changes.
Revenue	$28,073,095	$26,354,151	Inc. $1,718,944
Expenses and taxes	20,780,766	19,668,903	Inc. 1,111,863
Net revenue	$7,292,329	$6,685,248	Inc. $607,081
Interest	992,580	956,160	Inc. 36,420
Balance	$6,299,749	$5,729,088	Inc. $570,661
Dividends	4,868,031	4,868,007	Inc. 24
Surplus	$1,431,718	$861,081	Inc. $570,637
Previous surplus	9,319,285	8,458,204	Inc. 861,081
Total surplus	$10,751,003	$9,319,285	Inc. $1,431,718

Expenses in detail follow:

General expenses	$14,727,407
Rentals	1,568,534
Maintenance and reconstruction	3,591,065
Taxes	575,332
Equipment	318,428
Total	$20,780,766

The capital stock remains at $97,370,000, of which $29,496 belongs to and is in the treasury of the company.

The funded debt at the close of the fiscal year was as follows:

Funded and real estate mortgage, bonds due May 1, 1950 (4½ per cent.)	$13,000,000
Collateral Trust bonds, due January 1, 1938, against which bonds and stock bearing guarantee of interest or dividends, at 6 per cent. per annum, deposited with the trustees (5 per cent.)	8,504,000
Total	$21,504,000

During the year the $1,158,000 7 per cent. building bonds were paid off and retired. To provide the money necessary for that purpose, $1,000,000 4½ per cent. funding and real estate mortgage bonds were issued; $2,000,000 of the same class of bonds were also issued, the proceeds thereof to be used solely for improvements, betterments and extensions; $2,000,000 collateral trust 5 per cent. bonds were exchanged for the same amount of the capital stock of the New York Mutual Telegraph Company, upon which dividends of 6 per cent per annum were paid. The bonded debt of the company has, therefore, been increased from $19,660,000 to $21,504,000. The increase of the interest charges is, however, only $54,040 per annum.

The following table shows the progress of the company at different periods from 1866 to 1902:

	1866.	1890.	1902.
Miles of wire	75,686	678,997	1,029,984
Offices	2,250	19,382	23,567
Messages	5,879,282	55,878,762	69,374,883
Receipts	$6,568,925	$22,387,028	$28,073,095
Profits	$2,624,919	$7,312,725	$7,292,329

There were added to the company's system during the year 2,526 miles of poles and 57,218 miles of wire and 329 offices. The total now is 196,115 miles of poles and cables.

The number of messages increased 3,717,834 over last year. This does not include messages sent over wires leased by brokers, press associations, etc., or by railroads between their local stations. The receipts of regular commercial messages increased $1,348,531, and from leased wires $451,749. The average tolls for the messages transmitted were 31 cents, and the average cost 25.7 cents. There was expended for construction during the year $2,188,101.

Since April 1 contracts have been negotiated and closed with 14 railroad companies, covering over 16,800 miles of railroad.

The report is the best that has been made since 1893. The feature observed with especial interest was the average message receipt, which was 31 cents, and the average message cost, which was 25.7 cents. There has been hope that the management would find a way to reduce the message cost. In 1878, Western Union had average receipts per message of 38.9 cents, and the message cost was 25 cents, a drop of 10 cents per message in about three years. In 1889, the average receipt per message was 31.2 cents or about the same as at present, while the average cost per message was 22.4 cents, the lowest in any year of record. For the last seven years, the average receipts have been very stable while the message cost has been advancing a little. It has been strongly felt that the way to add materially to Western Union profits was to cut down the message cost, but it seems to have been impracticable to do this with the old-fashioned method of manual operation still adhered to. The profits of Western Union were about as large in 1882, when the gross receipts were $17,114,165, as they were last year, when gross receipts were $28,073,095. The profit on handling over 69,000,000 messages was only a trifle larger than the profit on handling 39,000,000 messages.

Wagner Motor Litigation.

Judge Townsend handed down a decision October 10 in a suit brought by the General Electric Company against the Wagner Electric Manufacturing Company, claiming an infringement of patent No. 430,328, granted June 17, 1890, to Elihu Thomson for an alternating-current motor. The invention covered by the patent in the specification is stated by the patentee to consist, broadly, "in arranging the motor so that as a structure its armature will have a different circuit arrangement at the start than those which will exist when it is up to speed, or well started in rotation. To accomplish this, the motor is started with the armature circuits commutated or changed, so that the armature will receive an initial impulse of rotation, after which, when the desired speed has been obtained, the connections are so modified either automatically or at the will of the operator, that the circuit of the armature will be locally closed on itself and commutated. Briefly, the invention consists in commencing to run the motor with a different circuit arrangement for its armature from that which it will have under its condition of steady normal working or running, such primary condition being only adapted to give torque, that being continued for a sufficient time will bring the motor up to the speed where it may run with the armature on continually closed circuit."

The defendants claimed that the clause "will receive an initial impulse" taken in connection with the locally-closed circuit after the desired speed is obtained, shows that the initial impulse is to be received by induction.

The Court held that the respective contentions are primarily directed to the interpretation of the term "locally-closed circuits" as used in the patent. It proceeds to say that Thomson originally proposed to patent broadly any method of starting motors "under a different set of conditions, or with a different structure, or with a different circuit arrangement from that which it will have under its conditions of stated normal working or running"; or by providing commutators only "in carrying out any method of starting." But upon citation of references, these statements of invention were erased, and the invention claimed was limited to only where *after* the initial impulse was received and on the attainment of a predetermined speed, the circuit of the motor armature will be locally closed of itself and uncommutated, or will be put on a "locally-closed circuit."

The Court held that the defendants have satisfactorily proved that the term "locally closed circuit" as used by Thomson in prior patents and generally, means a circuit disconnected from the main line, adding that the defendants claimed that the patent in suit is limited to a motor having its coils on a locally-closed circuit, after, but not before, the initial impulse of rotation is received. The defendant's motor starts by induction, and the motor coils are on locally-closed circuits on starting, in the sense that the circuit pertains to the armature alone, while on former trials the experts admitted that in the Thomson patent the coils are not on a locally-closed circuit on starting, but only on the attainment of the required speed.

In discussing the question at issue, the Court said that the defendants have developed the class of motors in suit, and are now met by the contention that this patent in suit—"a mere paper patent"—by a broad interpretation of its terms may be so extended as to embrace the defendant's construction, the effect of which interpretation would be to give the complainant the benefit of the broader claims rejected by the patent office. The Court said that it does not appear that any motor was ever made under the patent in suit, and that whether such a simple step as that taken by Thomson involved invention, or whether its confessed impracticability deprives it of all claims to utility, it is not necessary to determine. The conclusion of the Court is that defendants are entitled to the rule requiring a narrow construction of such a patent, and upon such a construction there is no infringement.

Electric Pumping Station for Sewage Disposal.

A FINE piece of municipal engineering has been completed at Pittsfield, Mass., and is illustrated in the accompanying views. The necessity for more advantageous disposal of sewage of this city has been appreciated by the authorities for some years, and about two years ago active measures were taken to install a more hygienic system than had previously been employed. Formerly, the entire sewage had been allowed to flow directly into the Housatonic River. Under the new method, however, it is pumped a distance of some two and a half miles from the outskirts of the city to large filter beds, where it trickles through the filtering material consisting of sand, to underdrains, and thus is discharged into the river clarified and harmless. The pumping station, by means of which this operation is performed, is the subject of the illustrations accompanying this article, and is, perhaps, the first electrically-driven pumping station for sewage disposal in this country.

The pump is a three-cylinder, clapper-valve sewage pump, manufactured by the Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, and is driven by a 85-hp synchronous motor, built by the Stanley Electric Manufacturing Company, of Pittsfield. The synchronous motor is of the well-known S. K. C. induction type, running at a speed of 900 r. p. m., and is belted by means of a jack shaft to the pump. It was at first intended to operate the driving gear of the pump directly from a pinion on the shaft, but the high speed at which this pinion was run was found to prohibit this construction, and the jack shaft was introduced, as shown in the illustrations. A friction clutch in the jack shaft between the motor and pump pulleys, respectively, allows the starting up of the motor without load. The frame work of the jack shaft is constructed on ways with screws and gear for sliding, so that it acts as a belt tightener.

The starting motor, seen at the right of the synchronous motor in one of the views is an S. K. C. self-starting polyphase motor of 7-hp capacity, and is belted by means of tight and loose pulleys to the shaft of the synchronous motor. This starting motor is connected to two up to synchronous speed and to throw it into circuit. The line circuit has a pressure of about 2,300 volts, at 7,200 alternations. Power is ordinarily taken from an auxiliary water-power plant in one of the Pittsfield mills, but the pumping station can be thrown at any time upon the regular city lighting circuits. The exciter is a direct-current dynamo, manufactured by the Northern Electric Company, of

FIG. 2.—PUMPING STATION.

Madison, Wis. It is belted directly to the synchronous motor. The field current of the motor is 5 amperes.

The pump is a Smith-Vaile pump, especially designed for this class of work. The valves are of the clapper type, leather seated, and are free from any possibility of becoming clogged. The pump is triple acting, and has a capacity of 2,000,000 gallons in 10 hours, de-

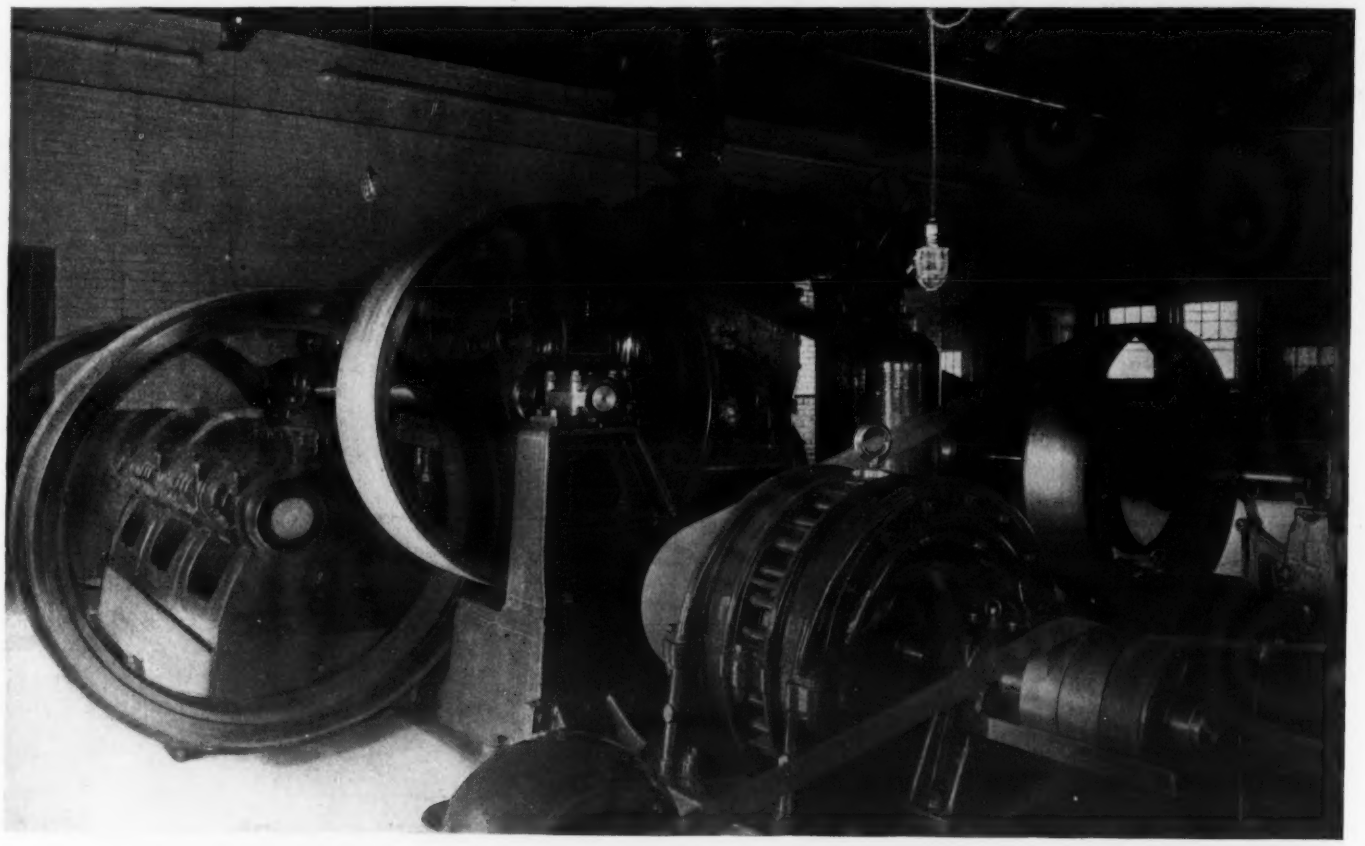


FIG. 1.—MOTORS AND PUMP.

S. K. C. transformers which reduce the line voltage to about 500 volts. The starting rheostat is of the water type, and is placed at the right-hand side of the switchboard. It consists of three blades cut in the shape of a quadrant, with a handle at the upper edge, and hinged at the apex. Upon lowering the blades, they are immersed in water contained in a rectangular tank, and the resistance in the secondary or rotor circuit of the induction motor is very easily regulated. In this way it is a very simple matter to get the larger motor livering at a pressure of 17 lbs. per square inch, the lift to the filter beds being about 54 feet. The cranks of the pump revolve at 29 r. p. m.

The pumping plant is operated only during the day time, and to provide for the disposal of sewage during the time when it is not in operation, large storage reservoirs of some 1,500,000 gallons capacity have been built underground between the pumping station and the screen house, seen in the rear of the general view. These reservoirs

are three in number, and are roofed with brick arches. To prevent any offensive odor from escaping from the reservoir, ducts are provided for carrying all gases, etc., to the base of the chimney, seen on the power station. Should the draft of this chimney be insufficient to carry off such vapors as may arise, a rotary fan, manufactured by the B. F. Sturtevant Company, of Boston, has been placed at the base of the chimney to assist in the ventilation. This fan is not yet in

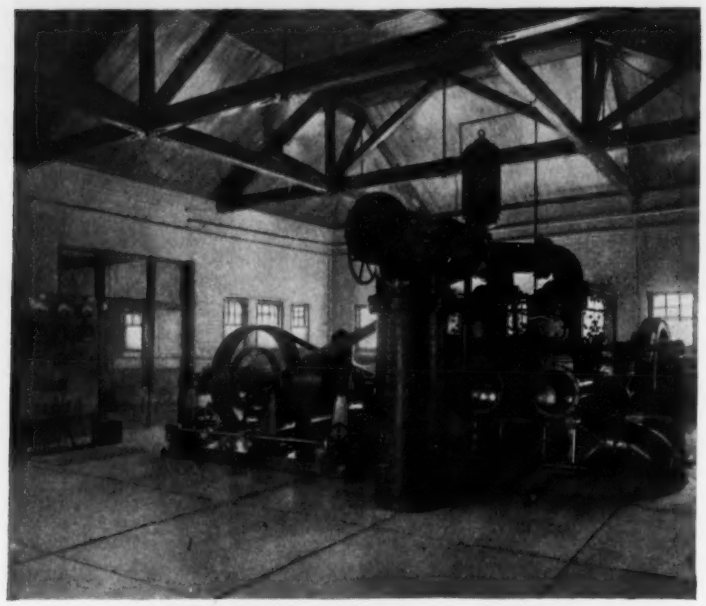


FIG. 3.—PUMP AND SWITCHBOARD.

operation, but as it is to work both day and night, and as the circuit to the pumping station is cut off at the central lighting station when the pumps are not in operation, it is probable that a water motor will be used for running the fan. A complete system of hot water heating, with radiators, has been installed. The boiler for this hot water system was built by the William Page Boiler Company. As will be seen from the illustrations, the pumping station is built for twice the capacity of pumps and motors now installed. The general dimensions are about 75 feet x 50 feet, the station being a regular cross. It, as well as the screen house, is built of brick, faced with repressed brick and trimmed with rock-faced Monson granite, and both station and grounds have a very pleasing appearance. The construction was under the direct charge of James C. Harding, assistant city engineer of Pittsfield, and it is through his courtesy that the above description is published.

The Calculation of Armatures.

At the July meeting of the Italian Association of Electrical Engineers, Prof. Luigi Pasqualini read a paper in which he considered some of the factors involved in the calculation of armatures. His paper begins with the statement that there is no unanimity of opinion among even the authoritative writers concerning the methods of calculating armature dimensions. Some writers would deduce the diameter in terms of the space occupied by the copper, the number of wires on the periphery of the armature and their section. Others assume the ratio between the diameter and the length of the armature, based on the data of successful machines. Others again assume conditions based upon secondary phenomena, for example, non-sparking at the commutator, a certain definite cooling surface, etc. Professor Pasqualini does not think that these secondary conditions are sufficiently important to be taken as an absolute base on which to calculate the more important dimensions of a machine. While it is logical to verify whether a machine as calculated by a different method, has sufficient cooling surface or can work without sparking at the commutator, it seems rational that only conditions based upon the essential phenomena of a machine ought to be used for determining the dimensions of an armature in a preliminary calculation.

There is a single condition from which it is logical to start, namely, that of a minimum amount of iron in the armature, for it is this condition which assures that the machine will operate with a minimum loss from hysteresis, and consequently, with the highest efficiency. If one assumes this condition he can arrive at extremely simple formulæ for establishing the dimensions of the armature in a first approximation. It will be assumed that the following data are given, which is generally the case:

E=electromotive force.
I=strength of current.
N=number of revolutions per second.
w=watts expended in an armature in joule effect.
p=number of pairs of poles.
p_1=number of pairs of brushes.
δ=density of current.
$\mathfrak{B}$=magnetic induction in the iron embraced by a coil at maximum flux.

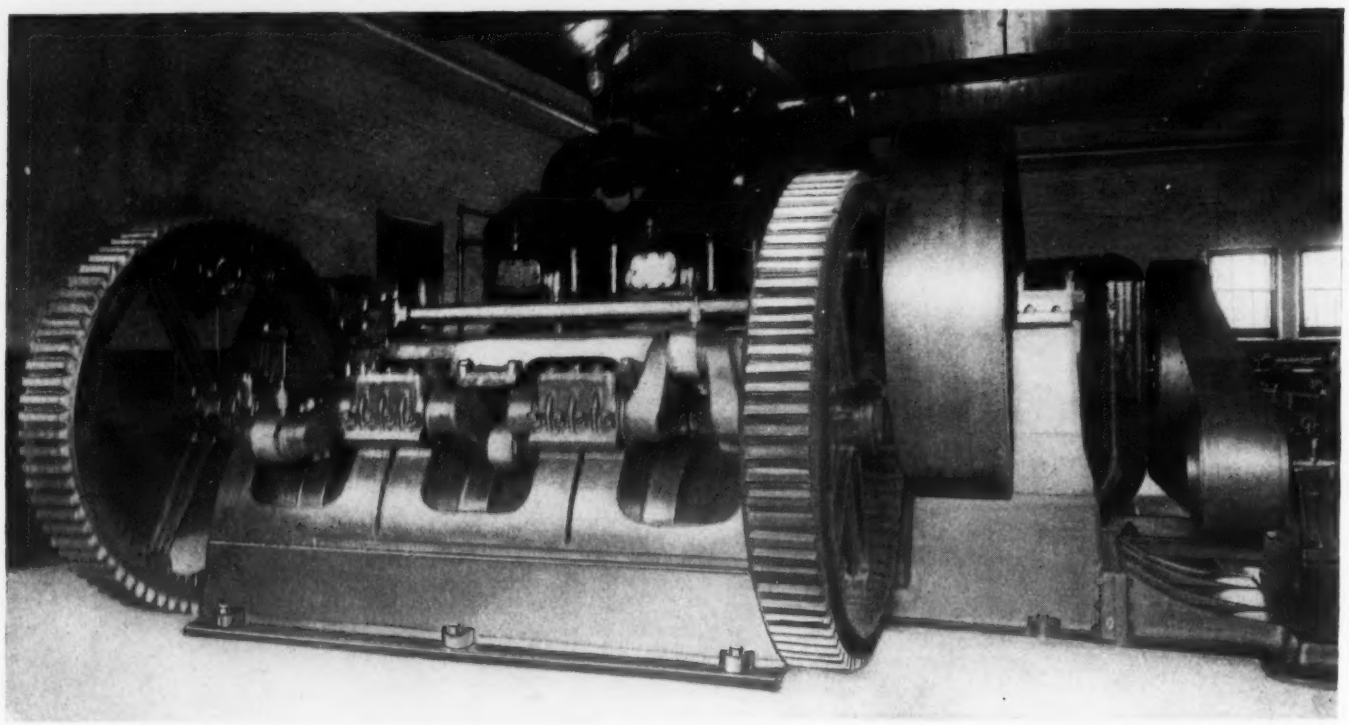


FIG. 4.—FRONT OF TRIPLE PUMP.

$\mathfrak{B}'$=maximum induction in the armature core.

The quantities to be determined are d, the diameter of the armature at the bottom of the teeth; l, the length of the armature core, and n, the total number of coils. Since we have w, I and S, the length, L, of an armature coil is evidently also known, for we have

$$L = \frac{2 p_1 w}{I \rho \delta}$$

in which ρ is the resistivity of the conductor. Calling h the thick-

ness of the core of a drum armature, we have for the volume

$$V = \frac{\pi}{4} (2\,d\,h - h^2)\,l \tag{1}$$

but we also have (Fig. 1)

$$\frac{h}{c} = \frac{\mathfrak{B}}{2\,\mathfrak{B}_1}, \text{ and } c = d \sin \frac{\pi}{2p}.$$

That is to say, $h = \frac{\mathfrak{B}}{2\,\mathfrak{B}_1}\, d \sin \frac{\pi}{2p}$, and from (1) we can write

$$V = \pi \left(\frac{\mathfrak{B}}{2\,\mathfrak{B}_1} \sin \frac{\pi}{2p} - \frac{\mathfrak{B}^2}{4\,\mathfrak{B}_1^2} \sin^2 \frac{\pi}{2p} \right) d^2\,l = k_1\,d^2\,l \tag{2}$$

where k_1 is a constant.

But we can express V as a function of s only or of d only. We thus have the flux expressed by

$$\Phi = \mathfrak{B}\,l\,c = \mathfrak{B}\,l\,d \sin \frac{\pi}{2p};$$

substituting in this expression from the relation

$$E = 2.10^{-8}\, n\, N \Phi \frac{p}{p^1}$$

from which it is seen that we can place

$$k = \frac{E}{2.10^{-8}\,\mathfrak{B}\,N \frac{p}{p^1} \sin \frac{\pi}{2p}}$$

we have

$$k = n\,l\,d \tag{3}$$

We have still another relation between l and d, since the length of a coil is given by

$$2\,a \left(l + d \sin \frac{\pi}{2p} \right)$$

where a is a numerical coefficient greater than unity. We thus have

$$L = 2\,n\,a \left(l + d \sin \frac{\pi}{2p} \right) \tag{4}$$

From (3) and (4) we have

$$l = 2\,k\,a \frac{d}{d\,L - 2\,a\,k} \sin \frac{\pi}{2p} \tag{5}$$

$$d = 2\,k\,a \frac{l}{l\,L - 2\,k\,a \sin \frac{\pi}{2p}} \tag{6}$$

substituting (5) or (6) in (2) we have

$$V = 2\,k\,k_1\,a \sin \frac{\pi}{2p} \frac{d^3}{L\,d - 2\,k\,a} \tag{7}$$

$$V = 2\,k^2\,k_1\,a^2 \frac{l^3}{\left(l\,L - 2\,k\,a \sin \frac{\pi}{2p} \right)^2} \tag{8}$$

V is a minimum when its differential is a zero; that is to say when

$$d = \frac{3\,k\,a}{L} \tag{9}$$

$$l = \frac{6\,k\,a}{L} \sin \frac{\pi}{2p} \tag{10}$$

We thus directly obtain very simple formulas which give us the best dimensions for the armature, the number of coils to be obtained by substituting (9) and (10) in (3.) The only empirical coefficient in this method is a, which depends upon the kind of winding chosen, and which for this very reason can be exactly determined.

The formulas (5) and (6) are not only very simple but they contain some interesting features. We see, in fact, that d, l, and n are not functions of k^1—that is to say, of the thickness of the armature core—which at first glance appears parodoxical; but it follows from the fact that a greater or less thickness will only vary the reluctance of the magnetic circuit. It is still more curious that the relation

$$\frac{l}{d} = 2 \sin \frac{\pi}{2p}$$

is constant and depends only on the number of poles and not on the dimensions of the machine, nor on the type of winding chosen.

The above method is applicable to the design of alternators with stationary armatures as well as to direct-current machines, for the fundamental equations are the same, there being only a different value of k.

In the case of ring armatures another condition must be taken into account, namely, the ratio between the diameter and the thickness of the armature core, a relation which may be fixed in advance with reference to mechanical considerations. If we suppose

$$h = \beta\,d$$

we have

$$V = \pi \left(x \frac{h^2}{\beta} - h^2 \right) l = k_1\,h^2\,l \tag{II.}$$

(3) and (4) become

$$n\,l\,h = k \tag{III.}$$

$$2\,n\,a\,(l + h) = L, \tag{IV.}$$

whence $$h = \frac{2\,a\,l\,k}{l\,L - 2\,a\,k}; \quad l = \frac{2\,a\,h\,k}{h\,L - 2\,a\,k}$$

substituting in (II.)

$$V = 2\,k_1\,k \frac{h^3}{h\,L - 2\,a\,k}$$

$$V = 4\,k_1\,k^2\,a^2 \frac{l^3}{(l\,L - 2\,a\,k)^2}$$

Equating the differential to zero we have $h = \frac{3\,a\,k}{L}$ $l = \frac{6\,a\,k}{L}$.

We thus see that the length of a ring armature ought to double its thickness whatever the capacity of the machine or the number of poles. From the two final equations we obtain the expression for the diameter

$$d = \frac{3\,a\,k}{3\,L}$$

and from (III.) or (IV.) we can calculate the number of coils.

Women as Farmers.

One of the principal speakers at the Farmers National Congress, which was recently held at Macon, Ga., was John M. Sahl, of Chicago, who discussed "The Labor Problem from the Farmers' Standpoint," and advanced the novel proposition that the future will see many women farmers. He said in part: "One of the most annoying, difficult and vital problems of farming is to get a sufficient supply of good labor. Farmers could hardly pay higher wages. But to a very small degree is it a question of more wages. The loneliness of farm life that has been so powerful in taking farmer boys from the farm and in keeping city laborers from it is fast passing away before rural free mail delivery, the farm telephone and the country trolley line. If, by education, a proper appreciation of our calling, and the introduction of business methods, we put farming on the same plane as other business enterprises, we can command for it our rightful share of the faithful, intelligent labor that now goes to railroading, manufacturing and merchandising. This will come to pass all the sooner because the future will see many women farmers. It is already fashionable for girls to be strong and muscular and athletic and sunburned. In farmwork so much machinery is used nowadays that the greater part of farmwork on the up-to-date farm requires intelligence and dexterity and application rather than muscular strength. Very much of farmwork is no more tiring on the muscles than operating a typewriter; it is much less wearing on the nervous system, and it is certainly much more healthful."

Sault Ste Marie Power.

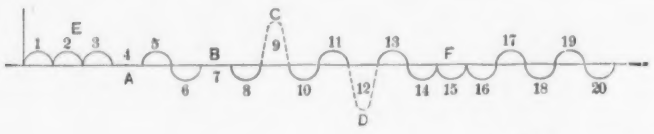
Next week will witness the celebration of one of the greatest events in the annals of the town of Sault Ste Marie. The Consolidated Lake Superior Company has made official announcement of the opening of the great plant of the Michigan Lake Superior Power Company October 25. Many notables will be present from various sections of the country including officers and stockholders of allied companies. More than 3,000 invitations have been sent out by the company. October 25 will be designated a civic holiday. Business will be suspended and the city lavishly garbed in holiday attire in honor of the occasion, which will mark a new era for the Soo and her people. The plant was elaborately described a few weeks ago in ELECTRICAL WORLD AND ENGINEER.

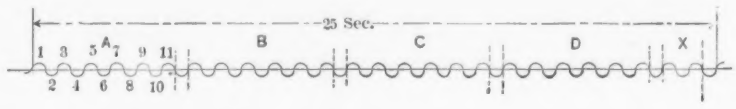
The Rowland Rapid Telegraph System—I.

AN examination of a diagram graphically representing an alternating current will show how it may be altered or modified in a number of different ways, any one of which modifications may, by proper methods, be used for sending signals over a line.

Fig. 1 shows an alternating current which has had certain of its waves modified in six different ways. The minus half-wave, 2, at *E* has been reversed, the minus half-wave, 4, at *A* has been cut-out—namely, the circuit was broken during the time the half-wave would have naturally continued had the circuit not been broken. At *B* a positive half-wave is cut out. At *C* and *D* two half-waves of opposite signs have been increased in height, and at *F* a positive half-wave has been turned into a negative half-wave. If the alternating current were, for instance, made to trace itself on chemical paper the above different modifications of its half-waves could readily be interpreted as six different signals.

In the Rowland system cut-out positive and negative half-waves





FIGS. 1 AND 2.—GROUPING OF WAVES.

are employed for sending the signals over the line. A single signal is, however, made to consist of a pair of cut-out half-waves, which are not adjacent. This method leads to the so-called system of "Wave-Groups." This is a very important feature of the invention, which may be described as follows:

GROUPING OF THE WAVES.

Consider an alternating current, consisting of a series of positive and negative half-waves, as shown in Fig. 2. We may divide these half-waves into groups, as *A, B, C D,* and *X,* leaving an extra half-wave between each group. If we now cut out of each group two or more of its half-waves, a signal may be made to consist not of one cut-out half-wave, but of a *combination* of half-waves cut out from a group. For instance, if the half-waves 1 and 3 are cut out from group *A,* this could be interpreted to mean one thing, while if the half-waves 1 and 4 were cut out this combination would mean another thing, and so on through all the possible combinations of the different half-waves in the group. In practice, in the Rowland system, the signals are made up by cutting out any two half-waves not adjacent. We then have the following possible number of different signals which may be obtained in this way from a group of 11 half-waves:

1—3, 1—4, 1—5, 1—6, 1—7, 1—8, 1—9, 1—10, 1—11.
2—4, 2—5, 2—6, 2—7, 2—8, 2—9, 2—10, 2—11.
3—5, 3—6, 3—7, 3—8, 3—9, 3—10, 3—11.
4—6, 4—7, 4—8, 4—9, 4—10, 4—11.
5—7, 5—8, 5—9, 5—10, 5—11.
6—8, 6—9, 6—10, 6—11.
7—9, 7—10, 7—11.
8—10, 8—11.
9—11.

This gives a total of 45 possible different signals, any one of which may be sent over the line during a time in which the current makes 11 alternations.

The Rowland system, in practice, makes use of five groups of waves, with one extra half-wave between each group. In Fig. 2 the groups marked *A, B, C, D* have 11 half-waves each. The signals sent over the line, which are afterwards translated in a manner to be shown into printed characters, are made by cutting out some of the different combinations given above, of two half-waves from each of these groups. The fifth group, marked *X,* contains three half-waves, two of which are at certain times cut out automatically for purposes to be described later on.

SPEED OF TRANSMISSION OF SIGNALS.

Professor Rowland found that he could employ with advantage about 208 alternations of the current per second, and, hence, the 52 half-waves illustrated in Fig. 2 will pass over the line in one-fourth of a second, that is, any group of waves, as the group *A,* will repeat itself four times each second.

Suppose there are four sending operators, and each operator is assigned a special group of waves. Each time his group of waves recurs he can cut out from this group two half-waves, that is, send one signal over the line. Thus, four operators utilizing the groups *A, B, C* and *D* can send four different signals each quarter of a second. Thus, 960 different signals may be transmitted over the line in one direction in one minute. It should be noted that the signals are, in reality, sent over the line in succession, although the process occurs so rapidly that the four different operators appear to be sending their four different signals simultaneously.

Multiplexing of the messages is the term applied to the above process of sending several different signals transmitted by different operators over the line in one direction, though in such rapid succession that they may appear to be sent simultaneously.

The system, moreover, is also duplex. As will be more fully explained, the term duplexing means the sending of two different signals from opposite ends of the line in opposite directions. It will be shown later that the two signals sent in opposite directions may be transmitted at identically the same instant.

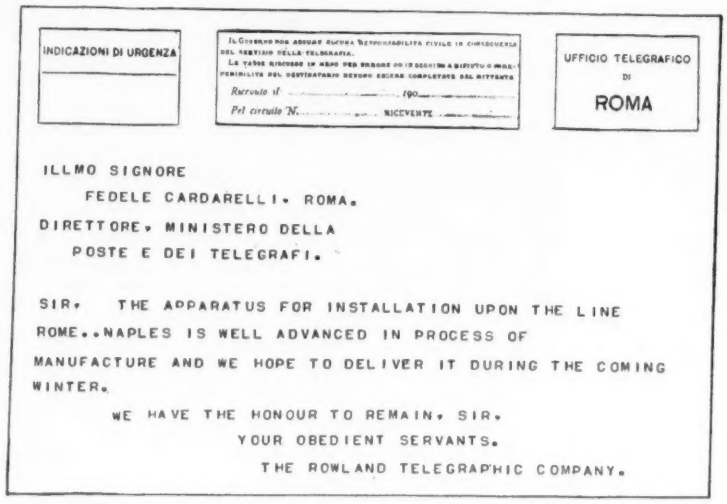
Since this system, then, is a multiplex duplex system, its total capacity for one wire is four different signals each way in one-quarter second, making a total of 1,920 signals that can pass over the line per minute.

Professor Rowland, moreover, developed his system so that the figures, the letters of the alphabet, and some extra signs are automatically printed in such a manner that each operator by writing on an ordinary Remington keyboard prints at the end of the line opposite to himself on a page eight inches wide. These pages of printed matter have the general appearance of an ordinary sheet of typewritten matter, with letters and figures printed in block type. (See Fig. 3 for specimen of the printing.)

Forty words per minute is an ordinary speed for a practised operator, so that altogether the eight operators may be printing over an ordinary telegraph line 320 words per minute.

SYNCHRONISM.

For converting the signals sent over the line in the form of combinations of cut-out half-waves into printed characters, the present


INDICAZIONI DI URGENZA

UFFICIO TELEGRAFICO DI ROMA

ILLMO SIGNORE
FEDELE CARDARELLI. ROMA.
DIRETTORE. MINISTERO DELLA
POSTE E DEI TELEGRAFI.

SIR. THE APPARATUS FOR INSTALLATION UPON THE LINE ROME..NAPLES IS WELL ADVANCED IN PROCESS OF MANUFACTURE AND WE HOPE TO DELIVER IT DURING THE COMING WINTER.

WE HAVE THE HONOUR TO REMAIN. SIR.
YOUR OBEDIENT SERVANTS.
THE ROWLAND TELEGRAPHIC COMPANY.

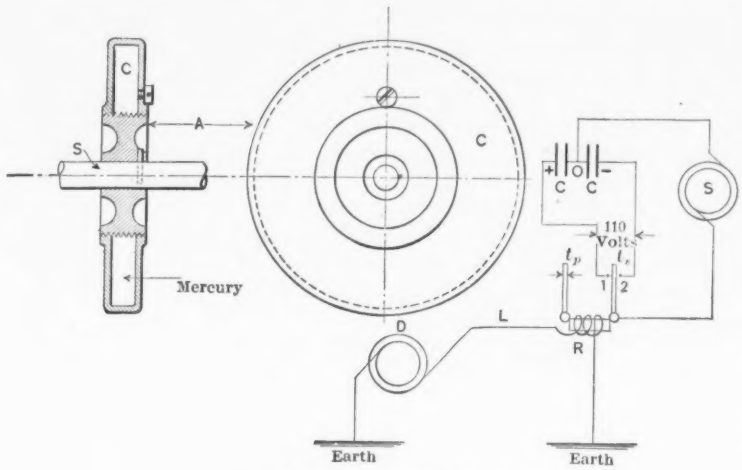
FIG. 3.—SPECIMEN OF PRINTING.

system requires that between certain parts of the rotating mechanism at each end of the line perfect synchronism be maintained. By this it is meant that two wheels in far separated cities shall revolve at exactly the same speed, and, furthermore, that when a certain point marked on the circumference of one of the wheels is in a particular

angular position a corresponding point on the other wheel shall be in exactly the same relative angular position.

The practical attainment of such synchronism constitutes one of the chief features of the system. This feature has been so perfectly realized in practice that the synchronism has never failed or given any practical difficulty whatever. The certainty of its action is independent of the length of line between any two stations. This accomplishment opens the door to a host of other important electrical and mechanical inventions, for, if, as will appear later on, cut-out wave signals can be converted into printed letters they may also be readily converted into a variety of mechanical operations, be it the steering and operation of a torpedo boat, the loading and handling of large guns at a distance or the operating of a distant type-setting machine, etc.

Having considered the chief principles of the invention, an outlined description may be given of the practical means by which the chief operations are performed.



FIGS. 4 AND 5.—SYNCHRONIZER.

METHOD OF OBTAINING SYNCHRONISM.

The endeavor to obtain perfect synchronism for telegraphic purposes has often been made. The failure to accomplish it has prevented several otherwise ingenious and carefully worked out systems of printing telegraphy from becoming a practical success.

It might at first sight appear that, since an alternating current is employed in the present system, synchronism could be easily obtained by merely passing the alternating current through a small single-phase motor. But experience has shown that this is not sufficient, on account of a phenomenon which engineers call "the pumping" of two machines, which otherwise run synchronously. This phenomenon may be easily and beautifully illustrated as follows: Connect up electrically an alternating single-phase motor with an alternating single-phase dynamo, and fasten to the shaft of one a disc on which are painted white stripes radially. The number of these stripes should preferably be the same or an even multiple of the poles of the dynamo. On the shaft of the other machine place a disc of tin with narrow radial slots cut in it to correspond in position with the stripes painted on the disc. The two machines with the discs attached to their revolving shafts should be so placed that the face of the painted disc may be observed by looking through the slots cut in the tin disc. When now the two machines come to rotate at the same velocity, the painted stripes observed through the slits of the other disc are plainly visible and appear nearly stationary. It will, however, generally be observed that the white stripes appear to oscillate backwards and forwards through an angle of several degrees, like the balance wheel of a watch. This observation proves that the speed of the motor is first gaining and then falling behind that of the generator, with an oscillatory motion. This is the so-called "pumping" of synchronous machines, and it often becomes so great that the two machines are thrown completely out of step.

For telegraphic purposes, the pumping must be entirely eliminated. This has been accomplished by employing a device called a "mechanical damper," which has been constructed in a number of different ways, but all the various forms involve the same principle, which will appear from the description which follows:

In Fig. 4 *S* is the shaft of a single-phase alternating-current motor of small size. *A* is a wheel of aluminum, in which is cut a circular channel, *C*. This channel is completely filled with mercury, and the wheel *A* is rigidly fastened to the shaft *S*.

Conceive the shaft and wheel with its contained mercury to be revolving at a high speed. If the speed of the shaft is subject to an oscillating decrease and increase, the mercury, on the other hand, will tend, by its inertia, to revolve at a uniform velocity, and a friction is, therefore, produced between the mercury and the walls of the aluminum channel when their speeds are alike. This causes the oscillations or "pumping" to dampen and the shaft to have a smooth, uniform rotation. The device is simple but effective, and without it a perfect synchronism would be impossible.

The synchronizer itself consists of a small alternating single-phase four-pole motor of special design. The armature is made of four flat coils, without iron, and has a diameter of about three inches. The synchronism is maintained by local currents. The line current, of from 30 to 70 milliamperes, has only one function to perform in keeping two tongues of a polarized relay of a special design in constant vibration. One of these tongues is employed, by the manner in which it makes certain contacts, to complete the local circuits which print the characters, and the other tongue serves to send positive and negative local currents through the coils of the synchronizer in a manner to preserve the synchronism. Fig. 5 shows the way in which this is accomplished.

The current from the alternator *D* on the line *L* keeps the two tongues, *tp* and *ts*, of the polarized relay, *R*, in constant vibration. *S* is the small synchronous motor, the shaft of which also carries the damper described above. One terminal of the synchronizer is attached to a wire which joins two one microfarad condensers, *C*, *C*, in series, and the other terminal is attached to the insulated tongue, *ts*, of the relay. The contact points, 1 and 2, of the relay are attached to the two terminals of the two condensers, which are in turn attached to the terminals of a 110-volt direct-current circuit, which keeps the condensers charged. An inspection of the diagram will show that, as the tongue *ts* vibrates between its contacts positive and negative currents are alternately sent through the synchronizer coils. In this way the synchronizer is made to run in synchronism with the dynamo *D* without the main line current being passed through it.

The synchronism obtained in this manner is so precise that, in the experiment described above, the stripes appear absolutely stationary, and if the motor is forcibly thrown out of synchronism it will regain it in from three to six seconds.

To further perfect the synchronism and to make the synchronizer self-starting, there are used, revolving between the same field poles as the synchronizer coils, some coils through which a direct current is passed. The coils, together with their commutator, form a small direct-current motor, which starts the synchronizer and also relieves it from doing any work beyond that of maintaining the synchronism.

DUPLEXING.

In order to duplex, namely to send signals over the line in opposite directions, at exactly the same instant, a dynamo and a differentially wound relay must be used at each end of the line. The current coming from each dynamo divides, part passing around one coil of the differentially wound relay at the same end, and then into the main line, and part around the other coil magnetizing the core oppositely to the first current, and into an artificial line. The method will be made clear from the following description and a reference to Fig. 6.

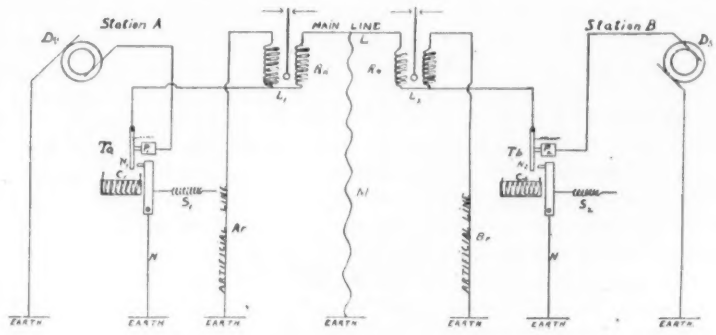


FIG. 6.—DUPLEXING ARRANGEMENT.

In Fig. 6, *A* and *B* are two stations at opposite ends of the main

line, *L*. *Ra* and *Rb* are two differentially wound main line polarized relays. *Da* and *Db* are two alternating-current dynamos, which may or may not be running in synchronism. *Ta* and *Tb* are two transmitters.

If the coil C_1 of *Ta* be energized, its armatures will break the circuit to the relay *Ra* at P_1 and immediately complete another circuit at N_1, which connects the middle of the relay coils to earth. The transmitter, *Tb*, operates in the same manner. When the coils of *Ta* and *Tb* cease to be energized, the springs S_1 and S_2 return the armatures to their original position. Now suppose that the circuit from the relay *Rb* be broken at P_2 and made at N_2 by energizing the coil C_2 of *Tb* at station *B*. The current from dynamo *Da* at station *A* will enter the coils of relay *Ra* at L_1 and there divide. Part of the current will pass through the right-hand coil of *Ra* over the main line, thence to earth, by way of the contact N_2. A portion of this same current will have leaked off the line to earth, as at *M*, and a small portion will go through both coils of the relay *Rb* and to earth, by the artificial line at station *B*. The other portion of the current of the dynamo *Da*, entering the relay *Ra* at L_1, will pass through its left hand coil, magnetizing the core in the *opposite* direction to that portion which passed through the right-hand coil, and then to earth by the artificial line at station *A*.

The resistance, the capacity and the self-induction of the artificial line *A* may now be varied until it imitates the real line *L* with its leakage, capacity and self-induction. When this is accomplished, the current which enters at L_1 will divide into two equal portions, half passing through the right-hand coil and half through the left-hand coil of relay *Ra*. Since these two equal currents flow in opposite directions through the two equal coils of *Ra*, the core is unmagnetized and the tongue of the relay will not vibrate, but stick against its left, or its right hand, contact, to whichever one it was last carried. If, when this condition is maintained, the circuit be broken at N_2 and again completed at P_2, the current from dynamo *Db* at station *B* will pass over the line *L* and through the right-hand coil of relay *Ra* at station *A*, magnetizing its core and causing its tongue to vibrate. Thus, when the artificial line *Ar* is properly balanced against the main line, an operator at *B* can send signals over the main line by merely breaking and making the circuit at P_2. In like manner, with the circuit broken at P_1 and made at N_1, the artificial line *Br* is balanced until the relay tongue *Rb* remains at rest, when the current from dynamo *Db* passes through its coils, but again vibrates when it receives current from dynamo *Da* at the opposite end of the line.

Thus, if a signal consists in bringing the tongue of either relay *Ra* or *Rb* to rest, that is, in making its tongue stick against one of its contacts, it is seen that the tongues of both these relays may be brought to rest either simultaneously or separately, or, in other words, if at the same instant the operator at *A* and the operator at *B* simultaneously energize the coils of their respective transmitters, both relay tongues come simultaneously to rest, and two signals have been sent in two opposite directions at precisely the same instant. It is curious to note here that when two simultaneous duplex signals are sent over the line there is zero current on the line.

METHOD OF CUTTING OUT THE WAVES.

The operation of cutting out the waves, for transmitting the cut-out wave signals over the line, is performed on an ordinary Remington keyboard. These keyboards are so constructed that the keys can only be depressed at intervals, corresponding to the passage of 52 waves over the line, that is, at intervals of about one-quarter second. The locking device which times the depression of the keys is called the "clapper" and unlocks the keys four times per second; that is, each operator can cut out four different wave combinations, and so send four different signals over the line, in one second. Each of the four keyboards can only cut waves out of the group which is assigned to it. The manner in which this is done, and how the waves can be cut out near the point of zero current over the line, may be understood by a reference to the following diagram: In Fig. 7 K_1, K_2, K_3, K_4 represent the four keyboards. Each keyboard is supplied with eleven insulated contact springs, 1, 2, 3, etc. To the frame of each keyboard is attached the negative terminal of a direct current 110-volt circuit. When any one of the 41 keys, belonging to a keyboard, is depressed, contact is made with some *two* of the 11 contact springs. The contacts made will be the combination which corresponds to the letter marked on the key *C* is a so-called commutator or "sun-flower." It is similar in construction to the commutator of a small dynamo, and has 52 segments insulated from each other. There are four sets of segments, which are connected respectively to the eleven contact springs of the keyboards K_1, K_2, K_3, K_4. The remaining eight segments are some of them entirely insulated, while others are connected to devices for cutting out waves used for automatic signals, but which are not shown in the diagram. In other words, the segments are divided up so as to correspond with the groups of half-waves shown in Fig. 2. The group *A* is connected to the contact springs of keyboard K_1, the group *B* to the contact springs of keyboard K_2, etc. Corresponding to the half-waves between the groups, *A*, *B*, *C*, etc., there are insulated segments which are shown in cross-section in the diagram. A brush or trailer, *t*, travels around the commutator *C* in synchronism with the dynamo *Da* being geared to its shaft. This trailer passes from the centre of one segment to the centre of the next, while the current from the dynamo, *Da*, makes half a wave. When the brush is at the middle point of a segment, the current from the dynamo is supposed to be passing through zero value.

If a key be now depressed on keyboard K_1, contact with the frame of this keyboard will be made with two of the contact springs, as, say, 7 and 11. When the trailer, sweeping around the commutator, reaches segment No. 11, which is connected to contact spring No. 11, the current from the 110 volt circuit flows momentarily from the positive pole through the coil *C* of transmitter *Ta* to the trailer *t*, from there to the segment No. 11, thence to the contact spring No. 11, to the frame of the keyboard and back to the negative terminal. This current causes the transmitter *Ta* to draw back its armature *A*

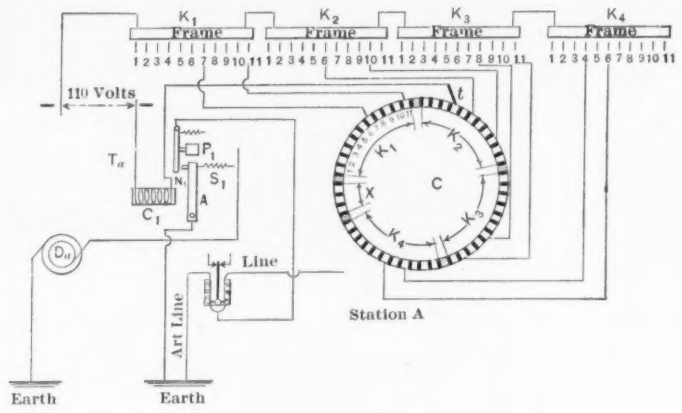


FIG. 7.—KEYBOARD.

and thus break the dynamo circuit at *P*, which goes to the relay and line, and at the same time the line is connected at N_1 to earth. Immediately, when the trailer passes off from segment No. 11 the spring S_1 pulls the armature *A* back, completing the line circuit with the dynamo *D*. Thus, a half-wave of group *A* (see Fig. 2) has been cut out of the line circuit. When the trailer arrives at segment No. 7, the same operation is repeated, because the contacts which are made at the keyboard continue for a period equal at least to the time that the trailer takes to pass over the 11 segments which are connected to that keyboard. In like manner the operators on keyboards K_2, K_3, K_4 can cut out, by depressing some *one* key, and *two* waves from the groups of eleven which belong to them. An insulated segment is placed between each two groups of eleven waves, so that, in case the last half-wave of one group and the first half-wave of another group is cut out, there will be an interval of a half-wave between these occurrences. This is found to be necessary for the proper operation of the main line relay at the receiving station.

It is now perfectly evident, from the manner in which these half-waves are cut out and the signals sent over the line, that each operator works independently of the others, and that no conflict between the signals which are sent by each can possibly occur; and it is also seen that four entirely different and independent signals can be sent in one direction in the one-fourth second that the trailer takes to pass around the commutator. Moreover, from the explanations given above regarding the method of duplexing, the cut-out waves sent over the line are seen in no way to affect the action of the home main line relay. This relay can only be affected by the cut-out waves which are sent to it from the distant station. Thus, the process is made clear how eight different and totally independent

signals may be sent over the line in one-fourth of a second, or, 1,920 in a minute.

The operation of cutting out the waves at the other end of the line is precisely the same. So far, however, we have seen that the signals which are sent over the line appear at the distant end merely as two momentary pauses in the otherwise constant vibration of the tongues of the main-line relay. We will next show how these transient signals are translated into a readable record and then, afterwards, into printed characters.

Computation of Regulation of Alternating Current Generators.

BY VIRGINIUS D. MOODY.

"The regulation of an apparatus intended for the generation of a potential, current, speed, etc., varying in a definite manner between full load and no load, is to be measured by the maximum variation of potential, current, speed, etc., from the satisfied condition, under such constant conditions of operation as give the required full load values."

"In apparatus which transforms, generates or transmits alternating currents, regulation refers to non-inductive load, *i. e.*, load in which the current is in phase with the e. m. f. at the outside of the apparatus, and is expressed in percentage of the full load value."—Report of the Committee on Standardization of the A. I. E. E.

In alternating-current generators, regulation is the ratio of the rise in voltage from full load to no load, at constant speed, to the full load voltage. The commercial tests that are necessary for this computation consist of "saturation" and "synchronous impedance" curves.

"The dependence of the induced e. m. f. or terminal voltage at open circuit upon the field excitation is the "saturation curve" of the synchronous machine, and consists of a straight part below saturation, a bend or knee and a saturated part beyond the knee, having the same general shape as the curve of magnetic induction."—Steinmetz, *Electrical Engineering*, p. 147.

In commercial testing, the data requisite for the no-load saturation curve is obtained as follows: The alternator is operated on open circuit at normal speed, and the residual magnetism of the field is removed by some convenient method, *e. g.*, reversal of the field current. The field current is then increased by small values, its value

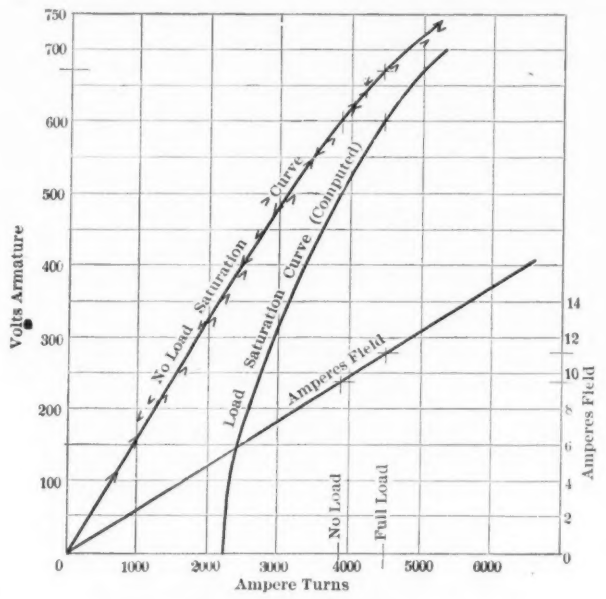


FIG. 1.—NO-LOAD SATURATION CURVE.

at each step being noted, as is also readings of armature voltage and field voltage. When the field is saturated, the field current is gradually diminished, the same observations being made.

In a log of a test for no-load saturation, machine on open circuit, the entries are as follows. Armature voltage, read for each value of field current. Field voltage, read for each value of field current. Field current, increase by small values going up on the curve; when the field is saturated decrease by small values coming down on the curve. Speed, held constant.

The curve is plotted between field ampere turns per spool, as abscissæ and armature voltage as ordinates. The field ampere turns per spool being found by multiplying the number of turns per spool by the field current.

The synchronous impedance of an alternator for a given excitation is the ratio of the induced armature voltage to the armature current at short-circuit for the same value of field excitation $Z = \frac{E_1}{I}$ where $Z = \sqrt{r^2 + x^2}$ is the impedance. This ratio will remain sensibly constant for all values of field excitation. Synchron-

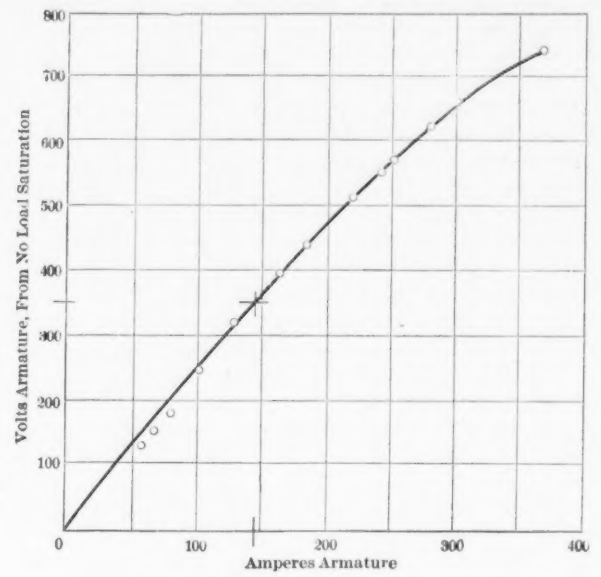


FIG. 2.—SYNCHRONOUS IMPEDANCE CURVE.

ous impedance (armature at short-circuit) involves not only the true resistance and reactance of the armature, but also the electromagnetic reaction of the armature current on the field flux.

In commercial testing the curve of synchronous impedance is determined as follows: The alternator is first heated up to satisfy the specification of "constant conditions of operation as give the required full load-values." This is done by short-circuiting the armature and operating the machine at normal speed and such an excitation as will give 1¼ times normal full-load current in the armature. The machine is run under these conditions until it becomes well heated up (1½ hours is sufficient for an alternator from 1,500-kw to 2,000-kw capacity, less time is required for smaller types). The excitation is then reduced to a value that will give normal full-load current in the armature, and the alternator is operated in this manner until it satisfies the "constant conditions of operation." This requires about half an hour for large generators.

As the field, even in the revolving field type, usually requires the longest time to attain its constant condition of temperature, and, therefore, of resistance at full load, the commercial test for constant conditions of operation, is to observe occasionally the field voltage for a given value of the field current. When the field voltage is constant for a given value of field current, the temperature and resistance of the field is constant, and the machine is in the specified constant condition of operation. With the generator in this condition, the test for the "synchronous impedance" curve is made. The armature is short-circuited, and the machine is operated at normal speed (slight variations of speed, however, will not sensibly effect the ratio, since the induced voltage and reactance are each direct functons of the frequency, and the IR drop is very small compared with the reactance drop). The field excitation is gradually increased by small steps, up to about 2½ times normal full load armature current, and the armature current and field voltage are observed for each step.

As the synchronous impedance of an alternator is the ratio of the induced voltage to the armature current for a given excitation $\left(Z = \frac{E_1}{I}\right)$, it is necessary to find the value of the induced voltage for the given excitation. The voltage induced in the armature for any given value of field current is the voltage corresponding to the given field current, as found in the no-load saturation curve, consequently the induced voltage for the successive values of field current may be taken from the no-load saturation curve, by noting the

armature voltage corresponding to the values of the field current.

The curve of synchronous impedance is plotted with armature current as abscissæ and armature voltage from the no-load saturation curve as ordinates. The resistance of the armature of the generator is measured after the test for the "synchronous impedance" curve.

In a log of a test for synchronous impedance curve, armature short-circuited, the entries are as follows: Armature voltage, taken from no-load saturation curve for each value of field current noted. Armature amperes, read for each step increase of field current. Field voltage, read for each step increase of field current. Field current, increased in successive steps up to about 2½ times normal full-load armature current. Speed, field constant.

The method of procedure for the computation of the regulation of an alternator, after having made the above tests, is illustrated by the following example: Alternating-current generator, three-phase, revolving field type, 8 poles, 150 kw, 600 r. p. m., 600 volts, 145 amperes at full load, 40 cycles, 400 turns per field spool, hot resistance of the armature between terminals, .0452. The no-load saturation curve and synchronous impedance curve, as taken in actual test on this generator, are shown on Figs. 1 and 2.

"The dependence of the terminal voltage upon the field excitation at constant full-load current flowing through the armature into a non-inductive circuit is called the 'load saturation curve' of the synchronous machine. It is a curve, approximately parallel to the no-load saturation curve, but starting at a definite value of field excitation for zero terminal voltage, the field excitation required to send full-load current through the armature against its synchronous impedance.

"The effect of saturation on the characteristic curves of the synchronous machine is as follows: The compounding curve is impaired by saturation. That is, a greater change of field excitation is required with changes of load. Under load the magnetic density in the armature corresponds to the true induced e. m. f., $E_1 = E + Ir$, where E is the terminal voltage, I the armature current, and r the effective resistance; the magnetic density of the field, to the virtual induced e. m. f., $E_2 = E_1 + Ix$, where x is the self-inductive armature reactance. Both, especially the latter, are higher than the no-load e. m. f. or terminal voltage, E, in the generator, and thus a greater increase of field excitation is required in the presence of saturation than in the absence. Due to the counter m. m. f. of the armature current, the magnetic flux which leaks from field pole to field pole through the air, increases under load, especially with inductive load where the armature m. m. f. directly opposes the field, and thus a still further increase of density is required in the field magnetic circuit under load. Therefore, at high saturation the load saturation differs more from the no-load saturation curve than corresponds to the synchronous impedance of the machine.

"The regulation becomes better by saturation; that is, the increase of voltage from full load to no load at constant field excitation is reduced, the voltage being limited by saturation."—Steinmetz, *Electrical Engineering*, pp. 148-149.

The load saturation curve is computed from the "synchronous impedance" and no-load saturation" curves, the computations being made of load, field, ampere-turns for armature voltage, varying in steps from zero to a few hundred volts above full-load normal voltage of the machine. In the case under consideration computations

LOG OF FULL-LOAD SATURATION CURVE (COMPUTED).

1	2	3	4	5	6
Armature volts	Armature volts + IR drop armature	Full load armature current	Ampere turns for armature volts + IR drop, from no load saturation (B)	Reactive ampere turns (A)	Load ampere turns ($C = \sqrt{A^2 + B^2}$)
0	6	145	50	2170	2173
50	56	"	350	"	2197
100	106	"	660	"	2265
200	206	"	1275	"	2520
300	306	"	1900	"	2885
400	406	"	2525	"	3330
500	506	"	3200	"	3860
600	606	"	3950	"	4500
700	706	"	4850	"	5310

of load field ampere turns are made for armature voltage varying between zero and 700 volts, the alternator being designed for 600 volts at full load.

The foregoing values are computed as follows: The IR drop in the armature $= I \times \frac{\sqrt{3}}{2} \times R$; I (full-load armature current), $= \frac{Kw\ 2}{E \times \sqrt{3}} = \frac{150}{600 \times 1.73} =$ 145 amperes; R (hot resistance of armature between terminals) = .0452. Therefore the IR drop $= 145 \times \frac{1.73}{2} \times .0452 = 6$ volts.

This IR drop of 6 volts is added to the armature voltage in column 1, and the sum of the two gives the 2nd column in the above log. Field ampere turns for armature volts + IR drop armature, are read from the no-load saturation curve (Fig. 1). For example, taking 206 volts in column 2, on the ordinate of this curve, volts armature run from 206 volts horizontally to the no-load saturation curve, then vertically down and read the field ampere turns 1,275.

Reactive ampere turns, column 5, are found as follows: On the synchronous impedance curve (Fig. 2), note that the armature voltage corresponding to the full-load current of the machine, 145 amperes, is 350 volts; then referring to the no-load saturation curve, the ampere turns corresponding to 350 volts, the reactive ampere turns is 2,170.

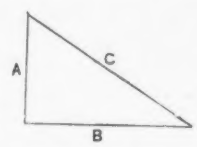


FIG. 3.

As the load saturation curve is the dependence of the terminal voltage upon the field excitation at constant full-load current flowing through the armature into a non-inductive circuit, it is plotted with load ampere turns as abscissæ and armature volts as ordinates.

In Fig. 3, let B represent the ampere turns for armature volts + IR drop armature, and A the reactive ampere turns: Then the load ampere turns $C = \sqrt{A^2 + B^2}$.

The load ampere turns as computed are shown in column 6 of the log. The load saturation curve is plotted in Fig. 1.

The regulation of an alternating-current generator being the ratio of the rise in voltage from full load to no load at constant speed, to the full-load voltage, may now be readily calculated from the no-load saturation curve and load saturation curve.

The full-load normal voltage of the generator is 600. In Fig. 1, on the load saturation curve, note that the field ampere turns corresponding to 600 volts armature is 4,475; on the no-load saturation curve the armature voltage corresponding to 4,475 field ampere turns is 668; then the regulation of the generator expressed in percentage of full-load voltage $= \frac{668 - 600}{600} = 11.33$ per cent. The amperes field of the machine at full load $= \frac{4475}{\text{number of turns per spool}} = \frac{4475}{400} = 11.19$ amperes.

The John Fritz Medal Banquet.

The arrangements for the banquet at the Waldorf-Astoria to celebrate the eightieth birthday of Mr. John Fritz and the successful founding of the gold medal bearing his name are being actively pushed, and a most successful and memorable evening is promised. The dinner takes place on Friday, October 31, at 7:30 P. M., and will be attended by some interesting ceremonies in connection with the formal presentation of the medal, which is to be awarded annually hereafter by a joint committee of the Civil, Mechanical, Mining and Electrical Engineers. There will also be some notable addresses, among the speakers being the venerable Abram S. Hewitt, Admiral Melville and Prof. Elihu Thomson. The full programme will shortly be announced. In the meantime, the work of the dinner committee will be greatly helped by the prompt forwarding of requests for seats. The tickets for the dinner cost $12 each, including wines and cigars, and $3 for ladies, who will occupy the boxes, and who will be served there with light refreshments. Application for as many tickets as may be needed, accompanied by check, should be sent at once to Mr. John C. Kafer, treasurer of the dinner committee, at the Engineer's Club, 374 Fifth Avenue, New York City. The large list of acceptances already includes the most distinguished names in the industrial arts and sciences in America.

Electrical Equipment of Antwerp Iron and Steel Works

From an electrical point of view one of the most interesting iron and steel works in the world to-day is that in course of erection on the banks of the Scheldt, on the Hoboken plains, near Antwerp, Belgium. When completed, these works will comprise a blast furnace plant, a steel works with a complete roll train outfit, iron and steel foundry, workshops, boiler and power houses, blacksmith shop, etc. The work is being rushed and the entire plant will be finished and in operation in a short time. Part of it is in operation now.

FIG. I.—MACHINE FOR CHARGING FURNACES OPERATED BY FOUR POLYPHASE INDUCTION MOTORS.

When the plant is in full swing it will require 4,200 tons of iron ore, 1050 tons of limestone, 2,100 tons of coke and 3,000 tons of coal every 24 hours, the manipulation of which will be done almost entirely by electrical means. The coke works with recovery of bi-products is supplied with a washery and coal mixing plant. In addition, there will be a plant for transforming the refuse from the washers into briquettes. A cement factory, with a daily output of 100 tons, will convert the blast furnace slag into building or paving stones.

A tube works with an output of from 40,000 to 60,000 tons of tubes annually, varying from 1½ inches to 40 inches in diameter, is also included in the plant. The steel works proper will produce 1,200 tons of basic open hearth steel per day, which will be smelted in tilting furnaces especially adapted for receiving the pig iron direct from the blast furnaces. The scrap will be melted down in four furnaces with a capacity of 20 tons. The rolling mills will consist of two divisions; in the one, girders, rails, angles, rounds, bars, etc., will be produced; in the other, plates and sheets of the customary lengths, widths and thicknesses will be rolled. Electric drive is used throughout all the various shops, the energy being obtained from a well-equipped power house centrally located.

This power house is essentially Westinghouse in all its appointments, and it will eventually have a capacity of 30,000-hp. The present plant consists of steam driven generators. There are two main sets consisting of triple expansion marine engine direct connected units. The engines are of 1,500-hp capacity each, with cylinders of 22, 32 and 46 inches in diameter. They were originally installed on an English torpedo boat, but have been reconstructed and provided with Sisson speed regulators. Each engine is provided with surface condensation, having a centrifugal pump for the water circulation. The condensation water returns to the boilers. The two main generators are three-phase machines of 900-kw capacity each, operating at 50 cycles, 2,200 volts and 187 r. p. m. They are of the rotating field type. A third main generating set is also in use, but this has only been put down temporarily pending the completion of a part of the proposed gas-driven installation. This set consists of a belt-driven 400-kw three-phase alternator of the rotating armature type, generating an e. m. f. of 2,200 volts at 50 cycles. This machine will eventually be driven by an 800-hp compound tandem engine. The exciting plant consists of two 25-kw direct coupled sets, each being a 58-hp Westinghouse compound engine with a 220-volt direct current multipolar generator built on an extension of the engine shaft. The engines run at 350 r. p. m.

The central station switchboard connections are arranged for running the alternators in parallel, but two sets of high tension bus bars are provided, the object being to isolate the generator supplying the rolling mills from the other generators, which would be engaged in furnishing energy for general distribution. This switchboard (Fig. 4) at present contains six panels—one for controlling the two 25-kw exciters, two for controlling the two 900-kw alternators, one for the rolling mill circuit, one for the boiler works, foundry and repair shop circuit, and one for controlling the lighting circuit.

There are four transformer sub-stations located in the works, each designed with reference to the circuits they are intended to operate. Station No. 1 is located at the entrance of the central station and furnishes current for the complete illumination of the steel works, and at the present time also furnishes current for all the motors in the central station. The steel works are illuminated by 200 Körting arc lamps and 500 incandescent lamps.

The extent of the electric drive and the variety of uses to which it is put make this plant an interesting study to those that are interested in the shop equipment of a modern manufactory. In the central station the following operations are carried on by means of electric drive. A 40-hp motor operates the air compressor; a 13-hp motor operates the Benny automatic stokers; two 20-hp motors operate the air pumps of the condensers; three motors operate the 30-ton crane in the engine room—one 40-hp for lifting, one 20-hp for shifting the car and one 30-hp for moving the crane. In addition to these motors there are two 21-hp motors for driving the feeder pumps of the water

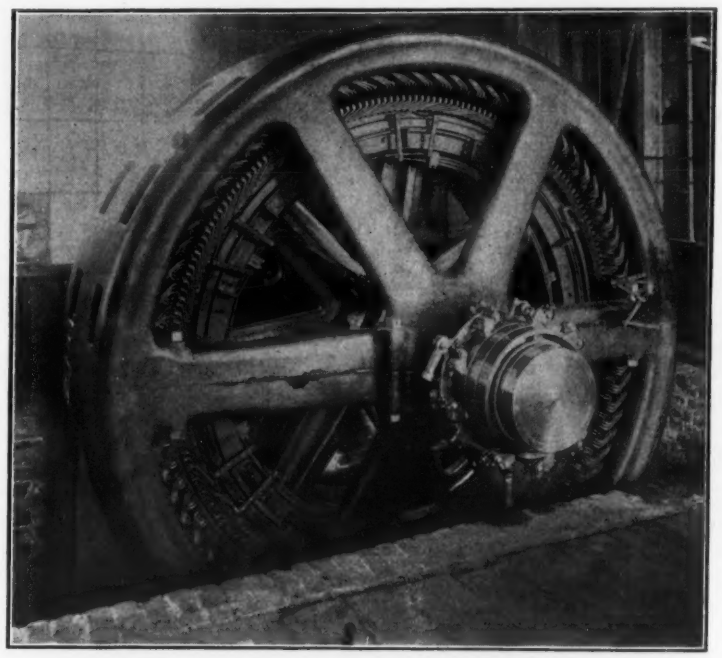


FIG. 2.—450-HP MOTOR DIRECT CONNECTED TO SHEET MILL TRAIN.

works and one 65-hp motor for the railway which will transport coal from the barges on the Escaut river.

Station No. 2 furnishes current for the low tension motors in the steel mills, including pattern and carpenter shops. The following are the uses to which the electric drive is applied in this station: One 20-hp and one 13-hp motor for cold-finishing shearing machines; one 20-hp motor operates a saw; one 5-hp motor operates a centrifugal pump for pumping water from the holes and furnaces; one 3-hp and one 5-hp motor for driving the machinery in the pattern and carpenter shop.

Station No. 3 furnishes current to the motors in the boiler works, foundry and repair shops. In the boiler works there are nine travelling cranes arranged as follows:

Room 1 is 42 feet wide and contains two 6-ton travelling cranes. Room 2 is 42 feet wide and contains a six and a twelve-ton crane. Room 3 is 82 feet wide and contains a 30-ton crane similar to the one used in the central station. Room 4 is 42 feet wide and contains a six-ton and a twelve-ton travelling crane. Room 5 is 42 feet wide and has the service of a 12-ton crane which goes out of the shop as far as the Escaut river, and also another 30-ton crane which is situated higher up and is utilized for the construction of the boilers.

One 60-hp motor drives all the machine tools of the workshop. The repair shops are operated by the following motors: one 50-hp, three 20-hp, and one 3-hp. There are also two travelling cranes of 5 and 20 tons capacity respectively.

The foundry contains two travelling cranes, one of 5 tons and the other 20 tons capacity. The following motors are used for the various purposes enumerated below: a 1-hp motor for driving a fan to dry castings; a 60-hp motor for driving the furnace ventilator and sand crushers; a 20-hp motor operating a sliding platform, and a Wellman charger for the Martin furnace, operated by four three-phase induction motors. These motors are of 3½, 15, 20 and 25-hp respectively.

Station No. 4 furnishes power to the following apparatus: A 65-hp motor operating the pump of the central condensing station; two 40-hp motors operating the tables at the rolls; a 20-hp motor in the repair shop; a 6½-ton and one 5-ton travelling crane; a 30-ton travelling crane; two 60-hp motors operating the shearers.

The most interesting feature connected with the electrical equipment of this plant, and one that bids fair to revolutionize the motive power for operating the rolls in iron and steel mills, is the installation of three large variable speed polyphase induction motors for operating the blooming and finishing mills. Necessarily the fly wheel capacity is large enough to overcome the inertia effects due to the sudden changes of load from minimum to maximum and vice versa.

The motors are controlled by railway-type controllers, having a primary 2,150-volt main and reversing switch, and three

FIG. 3.—GENERAL VIEW OF MILLS OPERATED BY POLYPHASE INDUCTION MOTORS.

drums for varying the resistances of the secondary circuit. The resistances are of iron and give fifteen steps in each phase. The speed variation gained by this means allows of a reduction of from 22 per cent. to 25 per cent. below normal speed, the normal full load torque being maintained over this range.

One of these motors is a 325-hp induction motor operating at 2,150 volts at a rated speed of 300 r. p. m. This motor is belt-connected to a 24-inch two-stand blooming mill, which runs at a speed of 70 r. p. m. and has a fly wheel of about 30 tons weight. In one stand 880 pound billets are reduced from 10 inches square to 3¼ inches square, in the other stand 450 pound billets are reduced from 7¼ inches square to 2¾ inches square section.

Behind the blooming mill are two finishing mills. Each finishing mill is supplied from one stand of the blooming mill. These mills are direct-driven by induction motors, the motors being coupled by rigid flange couplings to the short fly wheel shafts of the mills, each mill having a fly wheel of about 12 tons in weight. The larger finishing mill is a 14-inch five stand mill and is driven by a 450-hp motor operating at 2,150 volts; the other, a 10½ five-stand mill, is driven by a 325-hp motor operating at 2,150 volts and 6,000 alternations. It will be noted that

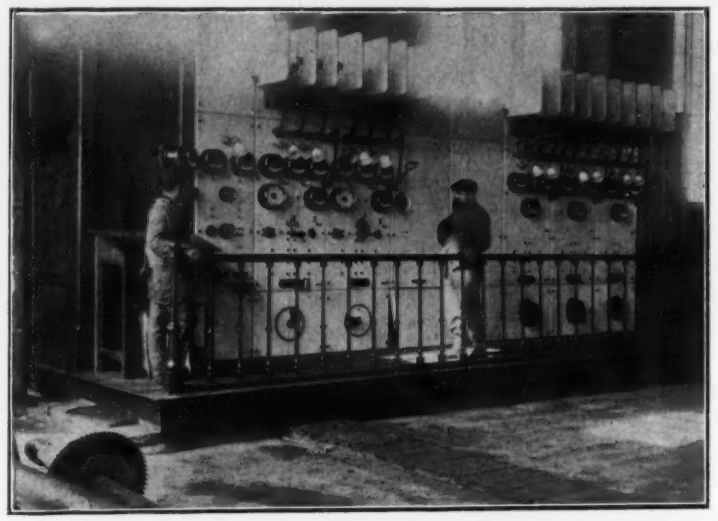


FIG. 4.—CENTRAL STATION SWITCHBOARD, ANTWERP STEEL WORKS.

the three large motors are operated at full line pressure, no transformers being used. Very high speeds have been chosen for all the cranes. At times the travelling speed is 330 feet per minute and the lifting speed 50 feet per minute. All lifting, turning and travelling drives are equipped with automatic, electromagnetic safety brakes.

Thus far it has not been possible to determine the exact amount of power required to roll the different sections of iron, as simply tightening the rolling train doubles or even trebles the power necessary to roll similar sections of iron. It has been ascertained, however, that the 325-hp motor belted to the blooming mill runs continuously at 35 to 45 amperes, and the 325-hp motor directly coupled to the finishing mill consumes on an average from 60 to 80 amperes. The 450-hp motor directly coupled to the finishing mills consumes on an average from 90 to 100 amperes. These motors have been running the roll trains for some time, and the results are highly satisfactory to the installing and operating engineers, as well as to the proprietors.

The contract for this apparatus was taken under very severe competition from European builders of electric apparatus, and it was only awarded to the Westinghouse Company after the merits of the various makes of apparatus had been fully investigated by the Antwerp people.

Officers of the American Street Railway Association.

Following are the new officers of the American Street Railway Association, elected at Detroit: President, Jere C. Hutchins, president Detroit United Railways, Detroit; 1st vice-president, W. Caryl Ely, president International Railway Company, Buffalo; 2d vice-president, W. Kelsey Schoeff, president Cincinnati Traction Company, Cincinnati; 3rd vice-president, P. S. Arkwright, president Georgia Railway and Light Company, Atlanta; executive committee, H. H. Vreeland, president Metropolitan Street Railway Company, New York; R. T. Laffin, general manager, Worcester Consolidated Street Railway Company, Worcester; Andrew Radel, vice-president Middlesex and Summerset Traction Company, Bridgeport; Walter P. Read, vice-president Consolidated Railway and Power Company, Salt Lake City; Willard J. Hield, general manager Twin City Rapid Transit Company, Minneapolis; secretary and treasurer, T. C. Penington, treasurer Chicago City Railway, Chicago.

Commercial Aspect of the Steam Turbine.

At the Detroit Convention of the American Street Railway Association, Mr. Edward H. Sniffin presented a paper, entitled "The Steam Turbine; Its Commercial Aspect," which gave information in detail of turbine plants now in operation, and discussed the cost of turbine plants and operation as contrasted with ordinary steam plants. In units as small as 400-kw, a result may be obtained of 14.47 lbs. of steam per brake horse-power per hour, corresponding to less than 13¾ lbs. per indicated hp. It is thus evident that moderate sized plants may with the turbine be sufficiently subdivided to give the maximum flexibility of service, with insurance of relay, and yet possess an efficiency heretofore identified only with very large units. Further than this, a fluctuating load is not incompatible with high economical performance. As the units become larger, the turbine is then brought into comparison with the best steam-engine practice, where it still preserves its uniform efficiency, and where its practical advantages are no less evident. In a recent instance, a result of 11.7 lbs. of steam per electrical horse-power per hour was guaranteed on a turbine of 750-kw capacity, corresponding to about 10.17 lbs. per indicated hp, which, though the size is moderate, is, perhaps, within the ability of but few engines of any size or type that have even been built.

Curves were given showing that the turbine requires about 80 per cent. of the space needed for the vertical engine, and not over 40 per cent. of that wanted for the horizontal. The vertical engine compares less unfavorably with the turbine than might generally be supposed, while the horizontal engine curve is about where one would expect to find it. The latter is not carried beyond 2,000 hp, this type of engine being practically limited in size to that required for the 1,500-kw generator.

Another set of curves showed the cubic yards of foundation material required, which was stated to be a more exact and striking comparison. The turbine would appear more advantageously still, if the actual foundations needed for stability had been computed. Instead, the foundations in all three cases were figured at 15 feet depth to give space underneath the engine-room floor for condensers, etc., though for large engines this depth is usually inadequate. The only foundation needed for the turbine is that necessary to hold its weight, as if it were a tank or some other stationary affair. It does not even require foundation bolts, there being no vertical or horizontal thrusts to be resisted. Comparing again the 1,000-kw units, it is found that in actual foundation volume required the ratio of the turbine to the vertical and horizontal engine is that of 1 to 9 and 15, respectively.

Other comparisons were given on the basis of cost. In the case of foundations, the basis assumed was $7 per cubic yard for concrete, laid. While the turbine seems to average a foundation cost of about 50 cents per hp, the vertical engine in the more frequent sizes is approximately $1.50, while the horizontal is not far from $2.50, not forgetting that all three foundations are figured of equal depth—15 feet—to provide space below, as before stated. In the instances where special foundation work is required, such as piling or otherwise preparing suitable bottom, or shoring up building walls to enable sufficient depth of excavation, the expense avoided by the use of turbines is obvious.

In a showing of the comparative engine-room building cost, the basis assumed was 15 cents per cubic foot of space inside of walls. The building cost for the turbine is about one-half of what is required for the horizontal or vertical engine, the latter two, apparently, not being far apart. Exigencies favor the turbine, because of its smaller size and rectangular proportions, and it not infrequently happens that increased power may be supplied by locating the turbine in existing space, whereas an engine would necessitate building extension, and, perhaps, the purchase of additional land. An instance of this kind arose at Akron, Ohio, where in the existing space no arrangement could be devised to accommodate additional engine power. It was found possible, however, by rearranging auxiliary apparatus, to provide space for one 750-kw and one 400-kw turbo-generator outfit, which will shortly be in operation.

Several actual cases were given to show the saving in cost. A plant was recently laid out to contain three 1,000-kw units, with vertical cross-compound Corliss engines. Subsequently three more 1,000-kw units were contracted for, steam turbines being ordered. It was found that the turbine saved 900 square feet of engine-room floor space and about 38,000 cubic feet. Had the whole plant been originally designed for turbines the saving of space would have been double these amounts, and the cost of land, building and foundations been reduced about $50,000.

An electric railroad plant in Ohio was some time ago installed, in which there are 500-kw generators direct-connected to cross-compound Corliss engines. Space was provided for two more units of the same size. For the increased power two 1,000-kw turbine outfits were purchased, which will go in the space left, and leave room for another turbine of 2,000 kw. Thus, the engine-room space planned for 2,000 kw is found sufficient for 5,000 kw. It is estimated that the boiler-plant extension will be reduced about one-third, because of improved efficiency. It is figured, too, that a saving of $2,900 was effected on each 1,000-kw foundation.

One other case, of perhaps greater interest, recently came to notice, that of a plant of 8,100-kw capacity, laid out on modern lines, employing vertical cross-compound condensing engines. There is no space for additional engine power, and any increase would require building extension and encroachment upon valuable land. It was shown that without going beyond the present building walls, and without disturbing the existing machinery, the plant might be doubled in capacity by installing turbines in the space available below the present engine-room level, and adding another deck of boilers. And it has been figured that this arrangement would effect a reduction of over $3 per kilowatt per annum in the present interest charge.

As to the cost of the turbo-generator outfit itself, it is stated that its price is reasonable; that, indeed, where the comparison is fair, the turbine will require the lesser first investment. The larger field for the turbine begins about where the high-speed engine leaves off. Its steam economy at once identifies it with the most efficient engine practice, and it therefore applies more appropriately to the classes of service where medium and large-size units are used. The comparison, then, lies generally between the turbine and the slow-speed engine. It remains merely to take an engine and generator of good construction, bring the engine efficiency as nearly as possible into parity with that of the turbine, also having it possess the same overload capacity, to find that the turbine is reasonable in price. And when we add the possible saving in foundations, buildings, etc., the first cost of installation is usually much in its favor.

The advantages of the turbine in parallel operation were brought out, and also in the use of superheated steam. The turbine may be used unreservedly with superheat of any feasible temperature. It has no internal rubbing surfaces, and there are no glands to become injured. Also, as no cylinder oil is required, there is no opportunity for lubricating trouble. Furthermore, there seems to be with the turbine rather more proportionate benefit from superheat than with the piston engine, because of diminished skin friction.

In closing the discussion on his paper, Mr. Sniffin said that the Hartford turbine plant has been running since the early days of its installation for some months whenever it was wanted. He added that the turbine was sold as a 1,500-kw machine, and that it is in operation only some two or three days a week, being a relay to the water power. It carries, however, a load from 1,800 to 2,000 kw, and, as a matter of fact, has carried, without any apparent difficulty 2,800 kw. There is a turbine at Wilmerding, of 400 kw, which has run since the first of February, ten hours a day, carrying its full load, generating current for factory power and for light. The Westinghouse Air Brake Company has four 400-kw machines that have been running for about three years, doing all the work of the factory. The economy is very high, and the repairs have been practically nothing. The company is now building four 4,000-kw turbines, three of which are for the Rapid Transit Subway in New York, to be used for lighting the subway. Four 5,000-kw turbines are to be built for the Metropolitan District Road in London, and will operate the entire system, and three 3,500-kw machines are being built for the Metropolitan Railroad of London. The De Beers Company, of Kimberly, South Africa, has ordered two 1,000-kw turbines, which will both be shipped within the next 30 or 60 days. Prof. Thurston, acting as engineer for the De Beers Company, will conduct a series of tests of these machines before they go. The Cleveland and Western Railway will put in two 1,000-kw machines for driving its new system, the turbines being now under construction.

Underground Work for Telephone Exchanges—VII.

BY ARTHUR V. ABBOTT, C. E.

DISTRIBUTION.

NO complete, far-reaching and universal scheme of distribution has been worked out and put into practice. There are now two general methods in use that may be termed *"Aerial"* distribution and *"Block"* distribution. Aerial distribution can further be subdivided into "Alley lines." "Back lot lines" and "House-top lines" Aerial distribution, whenever it can be used, is the most satisfactory and cheapest method, but in none of its forms could it be tolerated for a moment in the crowded portions of large cities. In most of the newer Western towns, the blocks are of greater size than those in the East. A narrow passageway or lane is built in the center of each block, on which the rear of the various lots abuts. This is not a thoroughfare in the ordinary sense of the word, although under the control of the city government, as it is rarely wide enough to permit vehicles to pass abreast, but is used for the delivery of goods, removal of garbage, ashes, etc. and an additional source of light and air. It is easy, even in the more thickly settled portions of the largest towns to obtain permits to erect light aerial lines in such alleys, for the purpose of distribution, particularly if work is so planned that lines do not cross the larger thoroughfares. The main distributing pole for each run is located inside the alley as near the street line as may be; a manhole is built in the conduit at the street and alley intersection, and from this manhole a lateral duct—preferably of iron pipe—is extended to the distributing pole and carried up alongside of it 10 or 15 feet, so that the cable may be secure from the attacks of street urchins. The general features of this method of construction are shown in Fig. 39. The cable to be distributed

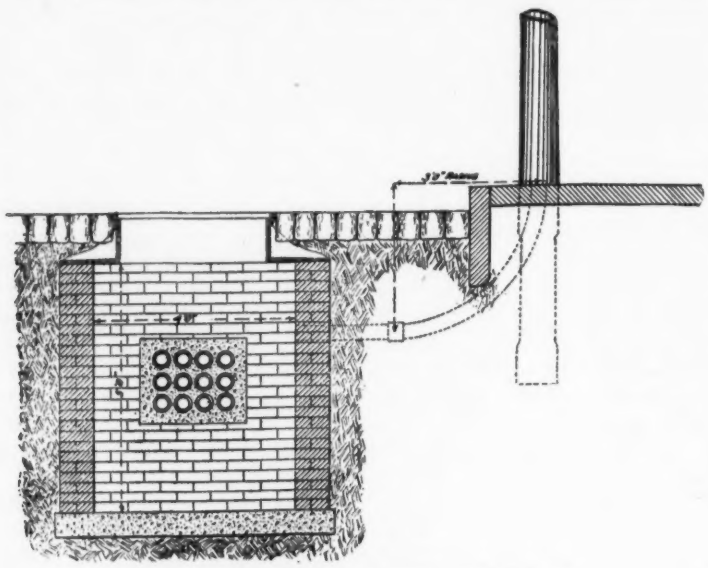


FIG. 39.—MANHOLE WITH LATERAL CONNECTION.

reaches the alley manhole in one of the main conduit ducts, and is then taken off through the lateral up the pole to a distributing box, and here the cable is fanned out and spliced to bridle wires that connect it to the open wire lines. The distributing box and general features of this plan are shown in Fig. 40.

Where alleys do not exist, it is often feasible to buy or hire the privilege of erecting a distributing line along the rear and between adjacent lots. Such lines are known as "Back-lot lines," but in constructive features differ in nowise from the regular alley line.

In cases where neither alleys exist nor back-lot rights can be obtained, a crow's-nest distributing pole may be used. Ordinarily speaking, two poles will suffice for the entire distributing system of a single block, and it must be a very obstreperous set of property owners who cannot be coaxed, cajoled or hired into granting the necessary rights. The crow's-nest pole is shown in Fig. 41. A substantial but tall pole is provided, to which, through the proper lateral duct, a cable is conducted from the nearest manhole, and terminated in a distributing box near the pole top. The pole itself is capped by a wooden ring about 5 feet in diameter, carrying insulators spaced about 4-inch centers. From the terminal box bridle wires are carried from the insulators, and from each one a clear span of bare copper—or preferably a twisted pair—is strung to the roof of the subscriber. This is an exceedingly valuable, flexible and cheap method of distribution, particularly where telephonic density is not excessive.

House-top distribution is accomplished by obtaining permssion to extend a cable through the usual iron pipe lateral up alongside the wall of a building, usually on the outside, though sometimes through an elevator well or light shaft, to the roof and terminating

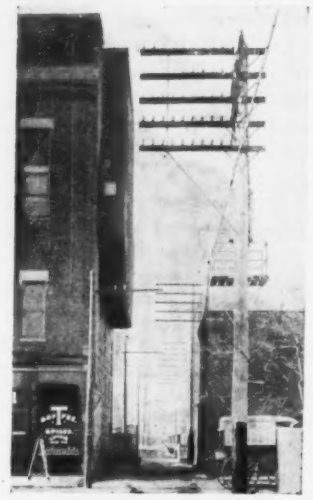
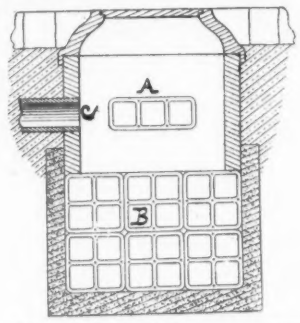


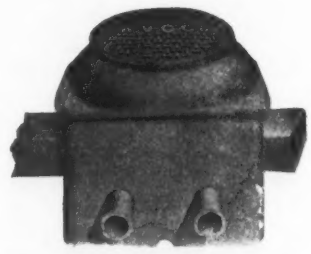
FIG. 40.—ALLEY LINE FOR DISTRIBUTION.

FIG. 41.—CROW'S NEST DISTRIBUTING POLE.

the cable upon a rack, either of iron or wood. From this rack, lines may be extended from all directions to small fixtures placed upon other housetops. Fortunately, some one of the aerial methods of distribution thus outlined can be employed in all but the most thickly settled portions of the largest cities, and by some one of these methods all those who require but one or two lines to a building or the so-called house-to-house distribution, can be cared for in a cheap and satisfactory manner. Examined critically, however, none of the aerial methods are truly underground distribution, as a whole cable in each case feeds into a pole line or housetop fixture, from which the true distribution in the shape of subscribers' drop wires takes place.

In the central portions of the larger cities, there is not an extensive demand for single-line distribution. Buildings are not only larger on ground plan, but higher and telephonically more densely populated. It is rare to find a half-dozen of the large modern office buildings to a single block, and the subscribers in each of these may be counted possibly by hundreds. It will pay, therefore, to open the street, put in a manhole, lateral, and run a large cable to a complete cable head in the basement of any such building. Such a system falls at once into the category of block distribution, and is interesting to the telephone engineer in the comparative ease with which he can fill up a 100 or 200-pair cable and gather in a goodly bunch of subscribers. Distribution is best accomplished by placing a distributing manhole at each street corner, with possibly one or two additional ones intervening. For this purpose no better plan is presented than shown in Fig. 42. The main conduit extends from





FIGS. 42 AND 42A.—TILE SERVICE DISTRIBUTION BOX WITH IRON SURFACE COVER.

street to street, as shown at *B*. Superimposed thereon the distributing ducts are placed as indicated at *A*. As often as may be, a service box, in reality a miniature manhole, is introduced, from which a lateral *C* runs to the building to be reached. The illustration by giving both a vertical and perspective view makes this method perfectly

plain. Where a small number of sub-stations is to be cared for and a less flexible and cheaper plan will suffice, the method of extending the lateral, shown in Figs. 43 and 44, will apply. In Fig. 43 the distributing conduits provide three ducts, and the service box two branches. On the multiple terminal system, two or three such boxes could be placed in each block, and a pair of 200 pair cables, one for each side of the street, looped successively through each

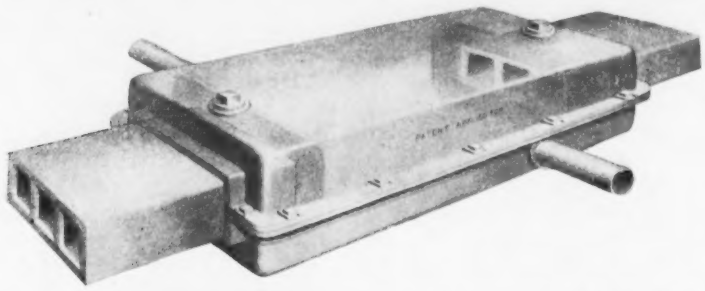


FIG. 43.—IRON SERVICE BOX FOR THREE-WAY CONDUIT, TWO SERVICES.

building passed, giving a system of almost perfect flexibility. The only drawback to this plan is the necessity of opening the street whenever access to the distributing box is required. In Fig. 44 the same general idea, but still further simplified to apply to a single cable, is shown.

The only really scientific and complete plan of underground distribution ever carefully worked out and thoroughly put into practice

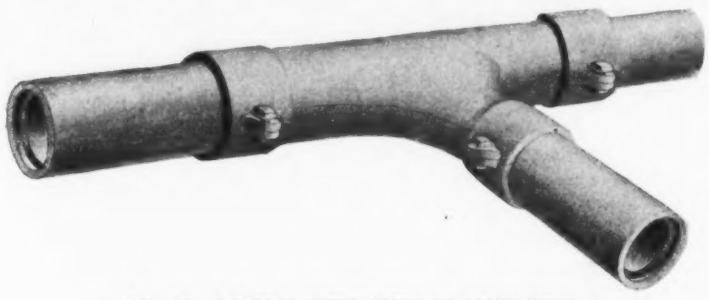


FIG. 44.—LATERAL CONNECTION TO MAIN DUCT.

is that devised by Mr. W. J. Johnston and introduced in the underground system of St. Louis. On the top of the main conduit a peculiarly shaped tile containing four compartments, as indicated in Fig. 45, is placed. This tile has side outlets on ether side placed opposite every property-owner along the conduit line. From these outlets, either at the time the conduit is constructed or subsequently as may be desired, lateral ducts are extended to and through the curb

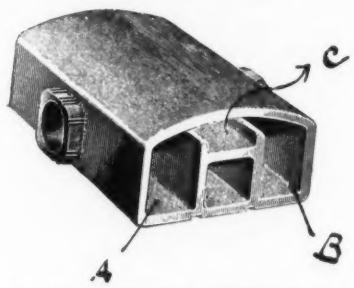


FIG. 45.—JOHNSTON DISTRIBUTING DUCT.

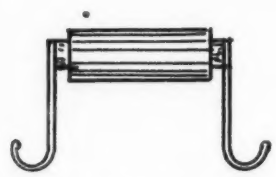


FIG. 46.—CARRIER FOR JOHNSTON DUCT.

wall of every building. In the main manhole at every street intersection, the cable to be distributed is potheaded, and "Okonite" ends are spliced on, which are drawn through the distributing ducts *A* and *B*. The duct *C* is always reserved for the carrier—a contrivance consisting of two iron hooks attached to a roller, shown in Fig. 46, or wooden shoe of such size as to easily travel through the carrier duct *C*. When introduced into this duct, the iron hooks extend over and reach into the distributing ducts *A* and *B* on either side, and are of such a height as to pass directly opposite the center of the outlet holes. Normally, the okonite wires lie at the bottom of the ducts *A* and *B*. If a house connection is to be made the carrier is hauled through the carrier duct *C*, but prior to starting on its journey an okonite pair is lifted and placed in one of the hooks. As the carrier is drawn along the hook lifts this okonite pair away from the bottom of the distributing duct and out of proximity to the remainder of the wires. Before the carrier starts workmen have been placed in the cellar of the building to be connected, have found the end of the lateral duct, the location of which has been carefully recorded, and have passed through this lateral a long wire grapple into the distributing duct. When the carrier arrives opposite the desired outlet the grapple can engage with the okonite pair that is thus separated from the other wires, which is easily drawn into the cellar of the building. For elegance in design, complete independence of one subscriber from all others and the avoidance of frequent street openings, Mr. Johnston's method leaves little to be desired, and is a marked contrast to the makeshift plans so often adopted of running a cable from a corner manhole to the nearest cellar, and then begging, buying, borrowing or stealing right of way through the premises of the various adjacent owners to reach all other subscribers in the block.

It cannot, however, be denied that the distributing duct plan is considerably more expensive—at least, so long as in the cellar-to-cellar plan circuits remain unmolested, yet rapidly increasing maintenance due to injury inflicted by predatory rats, mice, and the malicious small boy, coupled with the fact that property owners are awakening to the idea that for long, telephone companies have been obtaining a valuable concession for nothing, and are beginning to charge rental for such rights—causes the extra expense of the distributing duct to become significant.

Municipal Electrical Control.

At the recent Richmond meeting of the International Association of Municipal Electricians, Captain William Brophy gave a history of the municipal electrical department of Boston, which brings out in a striking manner the evils incident to municipal electrical control, even when it relates to what may be considered to some extent a legitimate function of city government. With such a condition existing in the city of Boston, one can imagine what the situation in other cities and towns would generally be were the municipal ownership of electrical plants the rule. Such plants as are at present in operation are, so to speak, on their good behavior owing to the weakness of the municipal ownership movement and the watchfulness of critics, yet instances of incompetency and fraud are by no means rare. To any who may believe in the theory of municipal ownership we particularly commend the narrative of Captain Brophy, for from it he may gain an idea of the manner in which the theory is apt to work out in practice. He said:

Boston's first experience in the supervision and control of electrical construction began in 1890 under an act of the Massachusetts Legislature, permitting all cities in the State to appoint an Inspector of Wires, whose duty was to inspect all overhead wires, their insulating supports, regulate their height over buildings, and cause to be removed all "dead" or unused wires, cause also to be placed in all low potential circuits, at the point where they enter buildings, a safety device to prevent the flow of excessive or dangerous currents therein, and to inspect all wires within buildings designed to carry electric currents for electric light and power. From motives of economy the superintendent of Fire Alarm Telegraph was made Inspector of Wires. In the first named position he was responsible and subordinate to the fire commission, composed of three members, while in the latter he acted independently of them, and was directly responsible to the Mayor to whose efforts the passage of the law creating the inspection of wires department was largely due. The police signal system was not in charge of the superintendent of fire alarm telegraph, for the reason that the police department is in charge of a commission appointed by the Governor of the State, the city being obliged to furnish such sums for its support as this commission may demand, so that we had two elecrical departments where one would suffice.

The efficiency of the new department created and placed in charge of the inspector of wires can best be determined by the qualifications of the men employed therein. The head of the department had no previous experience with applied electricity outside the fire alarm system, and his most intimate friends have never accused him of a desire to explore other fields of applied electricity during his term of office.

This department was not subject to the very excellent civil service law of Massachusetts, and as a result a grand scramble

began among the little statesmen past and present, members of the city government and their followers for positions therein, and the result will show how successful their efforts proved. The working force, aside from the clerical, was divided into two divisions, the exterior and the interior, and at the head of each was placed a chief inspector, the first having to do with overhead construction, the second having to do with by far the most important branch—electrical construction within buildings. Chief Inspectors were appointed and given charge of the men in each of these divisions. The Chief of the overhead division had had large experience in overhead construction, for the fire alarm system, having been employed in that department. It is needless to say that he was not the choice of politicians, and his lack of experience on high tension work was made the most of by them, but as their followers were only adept at wire pulling of a nature that would not qualify them as electrical experts, they could not prevent this man's appointment. Of those given him as assistants, but few would be employed by any private corporation or firm.

The most important task of this department was that of interior division, as the men therein were to pass upon the work of the most vital importance to the community—interior wiring performed by the most intelligent workmen employed in the electrical business. The Chief Inspector had previously been employed in a very humble position in a lamp factory, and for a short time in a very subordinate position by one of the electric lighting companies, but at the time of his appointment he was employed in the fire alarm department. This man who was honest and sincere had no previous training that would qualify him to do electrical construction or pass upon that done by others. Three more men were selected as inspectors, all of whom were engaged in humble but honest callings which could not be said to be suitable training schools in which they could receive a proper instruction for the important work they were authorized to do, and see that others did; one was engaged in tending the gates at a railway crossing, his duties being to close the same on the approach of trains and open them when they passed; another was engaged in trimming and cleaning arc lamps for street lighting, while the third was engaged as a helper in an establishment where dynamos were manufactured; mechanical or electrical knowledge he did not possess in the silghtest degree. Those most deeply interested in the success of this new department, viz., the electrical and insurance interests; those who believed it would add greater security to the community, give security to the honest contractor by forcing the unscrupulous or ignorant to bring the standard of work and material up to the highest point, reduce the losses by fire due to electricity and the cost of insurance, were not only disappointed but disgusted to see the aim and purpose for which it was created perverted by its organization as a nursery for the political heelers. No confidence was or could be placed in this organization by those most directly interested or the public in general. The newly fledged inspectors were looked upon with amusement bordering on contempt by all who were engaged in all branches of the electrical business, from the highest officials in the public utilities companies to the workmen and helpers.

One of the tasks specifically assigned to this department was the removal of "dead" or unused wires. Notice was to be served on the owners thereof to remove them, and in the event of failure to do so, they were to be removed at the expense of the owner. Hundreds of miles and thousands of pounds of such have been removed by this department and its successor, but no effort has been made to find the owners thereof or to collect the cost of such removal, the failure to do so being a direct violation of the law creating this department. The reason for this failure to comply with the law was obvious, it gave employment, or rather places, to a greater number of the political workers than would be the case were the owners of wires no longer compelled to remove the same. The city of Boston has spent thousands of dollars in the performance of this work unlawfully, as a gift to private individuals and corporations owing to the betrayal of its interests by its trusted (?) agents.

This electrical department was tolerated or permitted to exist until 1894. It accomplished little or nothing up to that time other than help deplete the funds in the city treasury; and it failed to inspire the confidence of any who had direct dealings with it. The fire underwriters kept up their excellent inspection service just the same as they had done before, which they would not have done had this electrical bureau deserved their confidence.

Previous to 1894 a public demand for the removal of overhead wires, poles, and fixtures from the streets of Boston was made that could not be ignored, and which resulted in the passage of Chapter 454, Acts of 1894, which authorized the mayor of the city of Boston to appoint a commissioner of wires, who should have charge of a department of said city to be known as the wire department. He was to receive an annual salary of five thousand dollars and to hold office for three years from the date of his appointment. It was made his duty and he was given exclusive authority to cause to be removed from the streets within a prescribed section which included the business portion of the city, all wires, cables and conductors and the poles and fixtures for the support of the same, with the exception of long distance telephone and the trolley wires of the street railways. This work was to be completed prior to the first day of January, 1900, when the wire department would cease to exist. The commissioner was given power to designate the manner in which all wires and cables should be run on or from poles and from fixtures, and all the powers and duties exercised by the inspector of wires were transferred to him, that office being abolished. He also designated the streets in which underground conduits were to be laid and the manner in which it should be done, but granting of permits to set poles was done by the board of aldermen. It will be seen then that this department was given the supervision of practically everything electrical in the city of Boston.

It was earnestly hoped by those who labored for the passage of the law creating this department, that profiting by early experience the head of this department would be selected from among those whose education, training and electrical experience would eminently fit them to fill such an important position, but they were again doomed to disappointment.

At that time the fire department was, as before stated, under the charge of a commission consisting of three members, and justly or unjustly, it had been the subject of the severest kind of criticism for a long time. It was charged by the fire underwriters and many large and influential property holders that it was inefficient as a whole and its members incompetent, and a demand for the removal from office and the appointment of a single commissioner in their stead was so persistently urged that the mayor appointed a commission of three eminent citizens to make an investigation of the condition of the fire department.

The report of this commission was adverse to the fire commission, and notwithstanding the favorable report of a joint committee of the board of aldermen and city council, who undertook to make an investigation on their own account, it was a foregone conclusion that this three-headed fire commission would be abolished by the Massachusetts Legislature, and a single commission substituted therefor. You can imagine the feelings of bitter disappointment and surprise with which the fire underwriters, large property holders and those engaged in the electrical business received the announcement by the mayor that he intended to appoint as wire commissioner a member of this board that had been so long the subject of adverse criticism. The reason given by him for making the selection was, that as fire commissioner this gentleman had under his immediate charge the fire alarm telegraph, and for that reason he must be thoroughly equipped with all the technical knowledge that the head of this new department should possess. As a matter of fact, however, he had never acquired even a speaking acquaintance with applied electricity in any form whatever. He had served his party well however in elective and appointive offices and was ambitious to secure future political preferment in the attainment of which he would have been seriously handicapped had he been ignominiously legislated out of his position as fire commissioner. This is the real reason given by those who were supposed to know, for this appointment.

The entire force in charge of the inspector of wires was turned over to the commissioner of wires who proceeded to add enough men to make the force large enough to add dignity and responsibility to a position with the comfortable salary of five thousand dollars per annum; provide places for his personal fol-

lowers, and those of a few of the other shining political lights.

The organization of the wire department was what might be expected under the circumstances. To the overhead and interior divisions of the old department was added the underground, the force in which consisted of seven men, as follows: A chief inspector; one civil engineer; two electrical engineers; one draftsman and two ordinary plain every day inspectors. The latter could have performed all the useful work required of this division, and as those who constructed conduits made their own plans and drawings, submitting copies of the same for the approval of the wire commissioner, the draftsman was not overworked, nor was he a crying necessity; and as they employed their own civil engineer such an official in the wire department proved to be superfluous. They also determined the merits of their underground cables and conduits and saw to it that they came up to the standard called for by the specifications as to conductivity, insulation and material, so that the two young gentlemen (both very worthy) who were employed as electrical engineers were not an actual necessity to the department in that capacity.

Of this entire force not one had any previous knowledge or experience in the construction or maintenance of underground conduits, cables or conductors. To nearly all, the proper mixture of mortar or concrete, the method of laying conduits, the construction of manholes, the drawing in of cables and splicing the same was a sealed book. It will readily be seen that the direction and supervision of this important work could not be undertaken by this class of men and to attempt to do so would be little less than a roaring farce. They were sent out to roam over the trenches, ostensibly to inspect and supervise the works while the only work actually performed was to obtain from those in charge the number of ducts, length in feet, kind, length of cable, and kind, to be incorporated in the annual report of the department.

The excellence of the underground electric system owned and operated by the electrical companies is due to their determination to construct them in the most thorough and substantial manner possible, and to render the disturbance of the surface of the streets unnecessary, and is not due to the knowledge, experience and forethought of the commissioner of wires and the class of men under him whom I have described. The telephone company had years of experience in the construction of underground conduits before the organization of the wire department, and a force of experienced engineers and workmen in its employ, while those who for the first time began the construction of conduits, secured experienced engineers and men from other portions of the country who needed no instructions from the commissioner of wires or his underground division. While the private companies could secure men of large experience, Boston would not, as it would be considered little short of an act of treason for the mayor or the head of a department to employ any but residents of Boston, and above all voters therein.

The overhead division was originally in charge of a chief inspector, but in this more pretentious department it was subdivided into the overhead and dead wire divisions, and an assistant to the chief inspector placed over each, three men being employed to perform the duties that could be easily performed by one. The methods pursued in this division, under this new arrangement, I will not give here in detail other than to say that a more ingenious method to accomplish as little as possible with the greatest possible number of employees could not be devised.

The interior division remained as it originally was, no change being made therein. There were two reasons for this. Owing to the open and severe criticism of its original makeup it was not deemed best to inject into it any of those who were being placed in the department mainly for political reasons; again, the public eye was not fixed on the wires, fixtures, etc., in the interior of buildings, but on the then unsightly poles in the street and fixtures on the house tops, together with the wires they were designed to support. They had made a demand for their removal and they watched the progress made in bringing about this much-desired result. There were those in the community (shrewd observers) who were uncharitable enough to say that the commissioner of wires would use his position to make people forget the fact of his long connection with the fire commission, the abolition of which seemed necessary for the public good; and for his political advancement towards the first goal of his ambition—the mayoralty of the city of Boston, by causing the removal of the overhead wires well within the time limit set by law; consequently, he had no time to devote to the interior division. This did not prove to be a misfortune. The men employed therein were honest, industrious and possessed of a desire to become proficient in their calling, and under proper instruction and direction, they made rapid strides forward. Additions to their number were very few and were made with care as to their qualifications. Owing to a wholesome fear of public opinion, this branch of the wire department was not made a resting place for political camp followers.

Owing to the inexperience of the commissioner of wires and his ardent desire to cause the streets to be clear of overhead wires well within the time limit, the amount of conduit construction which he decreed should be done was far in excess of what should have been attempted during the late season of 1894.

Owing to this mistake, when the season arrived when the excavation of streets should be discontinued, a large amount of work still remained to be done. This led to serious misunderstanding between him and those engaged in the construction of underground conduits, he contending that they were trying to embarrass him by not prosecuting the work diligently, while they with truth contended that such was not the case. This disagreement was intensified by the reports made by the underground force who, knowing well the feelings of their chief were quick to note any delays due to lack of material or unavoidable causes and magnify them. As the season drew near when work of this nature should end, the commissioner of wires became possessed of an intense desire to emulate the example of former Mayor Grant, of New York, and lead a brigade armed with axes to cut down the poles found standing in the street after a given date. There were two serious objections to the carrying out of this programme. Owing to the narrowness of the streets, tall poles in falling would crash into the walls of buildings standing thereon, and cause the suspension of traffic for an indefinite period, and the streets of the city and business houses would be plunged into darkness. This led him to cause an investigation of the subject by one in whom he had great confidence, the result of which was that the amount of work decreed to be done was greatly in excess of what could be accomplished within the time allotted therefor; and for this mistake those prosecuting the work could not be blamed, as with the utmost diligence the work could not be completed until well into February, and the connections could not be made to the underground system and the poles and overhead wires removed until much later in the spring months; that the cost of construction was very much greater during the winter than it would be during the summer season, and nothing was to be gained by delays in the prosecution of the work. In the face of these plain facts, the picturesque and realistic campaign planned against the poles and overhead wires had to be abandoned, thereby avoiding serious inconveniences, if not positive danger to the public and costly litigation to the city. There were many who regretted that this official did not carry out his threat to the fullest extent, thereby bringing forcibly to the attention of the authorities the evils that are sure to follow the vicious practice of the appointment to this important position as a reward for political services.

Soon after the organization of the wire department, the political complexion of the municipal government underwent a change, but to the credit of the mayor then elected he made no attempt to reward his friends and their followers for political work in his behalf through the medium of the pay roll of this department. At the expiration of his term the party opposed to him again came into power, and although the commissioner of wires was of the same political faith, it was decreed that he must be transferred to the head of another department to make room for another who was a powerful political factor, in fulfillment of a promise made before election that he should be appointed as the head of a department with a salary of not less than five thousand dollars per annum. The commissioner of wires strongly opposed this transfer from the wire department, as he very much desired to remain therein until the work entrusted to it was completed, the credit for which he could then take to himself and receive the plaudits of his political friends, and possibly the public, or at least a portion of it. But knowing

well that his appointment was purely a political one, and being a loyal party man, he yielded and vacated the office of wire commissioner to assume the duties of another equally remunerative one.

The new commissioner was as reluctant to accept the position as his predecessor was to resign it, as he desired to be appointed to the head of a department with the duties of which he claimed he was familiar. He frankly proclaimed that he did not possess the qualifications most essential to a successful administration of the affairs of this department, but the powers that were consigned him to this position against his will. He did not obtain the position through false pretenses, by having it proclaimed from the house tops that he was the very and only man for the position; he frankly admitted his appointment was for purely political reasons, and as his tenure of office was very uncertain, he would not attempt to acquire the technical knowledge that he felt the head of the department should possess. He trusted to his subordinates in whom he had faith to bring the work of the department to a successful issue, and never failed to give to each the credit to which they were entitled. It can be said that during his term of office the department reached its highest state of efficiency, although having dumped upon it men who could not be provided for in other departments, and whose political friends insisted on being placed on some one of the city's pay rolls. Although a believer in the doctrine that "To the victor belongs the spoils," he quickly saw the evil of applying the spoils system to a department designed as a protection for the public, and in his heart condemned it. To most of you it is not necessary to mention the name of this gentleman. He is a past member of this Association; most of you have met him at one of your conventions, while some of you have partaken of his generous hospitality in the "Hub of the Universe," and I am sure all who have known him have none but the pleasantest recollections of this glorious good fellow so full of generous impulses.

Shortly before the expiration of the term of office of this commissioner, another change in the political complexion of the city government took place, and it was well understood that the mayor-elect would not reappoint him; it was also given out that he would appoint some one thoroughly equipped for the position; but those who hoped to see such an appointment made were again disappointed as the selection made brought the office to the lowest level it could possibly reach, and one it is sincerely hoped it will never reach again.

The mayor announced himself as a business mayor before election, opposed to the practice of borrowing money to meet current expenses, and favored an increase of the tax rate so that this could be avoided, and pledged himself to conduct the affairs of the city on business principles, and to the surprise of most people, he was elected. He immediately set about securing the passage of an act by the Legislature to increase the tax rate, but he found himself bitterly opposed in this by the members of his own party, many of them thinking it would injure the party to touch the pockets of the people in this way. But there was that contingent in the Legislature who are always open to conviction—for a consideration in the form of official patronage. Among these he cast about to secure enough votes to pass his pet measure, but in order to do so he was obliged to promise to make appointments, all of which did not appeal to his best judgment. One member demanded as the price of his support of this measure the position of commissioner of wires. This was considered a pretty stiff price to pay for the service to be rendered, and was not readily agreed to; but as votes in sufficient number were difficult to secure, the terms named were reluctantly accepted so that the third appointment to the office of commissioner of wires during its short existence was secured through what looked very much like a corrupt political bargain, a vote and influence (if there was any) being secured, the price therefore being the sum of five thousand dollars per annum for a term of two years to be paid in monthly or weekly installments from the city treasury. So eager was this person to secure this princely salary to himself, that he took possession of the office immediately after his appointment, although serving as a legislator for a long time after; but his presence was not missed and the department benefitted by his absence, and would have derived far greater benefit had he remained away during his whole term of office.

In 1898 the Legislature extended the life of the wire department for a term of ten years, dating from the first day of January, 1900, but limiting its operations to clearing but two miles of streets each year, whereas it had caused an average of over seven miles per year to be cleared up to that time. Before the close of the retiring commissioner's term in May, 1900, he recommended a substantial reduction in the working force of the department owing to the reduced amount of work to be performed, which was done; later the mayor demanded that a further reduction be made, which was also done without impairing the effieciency of the department, thus reducing the amount paid for salaries from $54,773 to $36,000, a reduction of about 34 per cent. The mayor at this time declared that he would not approve the appointment of a single man whose services were not needed, no matter who desired it. He held to this resolution until a few appointments had to be made, as he claimed, in payment for votes secured at the state house, but some months later the bauble of a renomination was dangled before him and held beyond his reach until he finally turned the various departments over to what is said to be the worst gang of political spoilsmen that ever infested the City Hall. Every department except the fire and police was filled to overflowing, and the wire department came in for its share, every device possible was resorted to to find an excuse for the employment of the friends of the "gang." The expenses of the wire department were the largest in its history, 94 per cent. of which was for fixed salaries; the barrier so long erected between the interior division and the spoilsmen was finally broken down, and it was invaded; work was undertaken with which the department had, by the terms of the law creating it, nothing to do, some of which was as profitable to the community as bailing water from one side of the harbor and pouring it into the other, or taking the census of a graveyard—for the purpose of securing votes.

This "business" mayor made some of the worst appointments ever witnessed during the history of the city, for instance, a milk dealer as superintendent of public buildings, and the keeper of a small cigar stand, in which calling he was not a shining success, as commissioner of wires.

With nearly every department packed with their followers, this "business" mayor and the spoilsmen who had him so completely under their control, felt that his re-election was assured, but he went out of office the most discredited official, and with the largest vote cast against him of any man that ever occupied his position. His successor is a man of national reputation and is expected to give the city a clean and honest administration. One of his earliest and most commendable acts was to notify the person who masqueraded as, and drew the salary of, the commissioner of wires, that his valuable services could be dispensed with. I am not personally acquainted with the gentleman who has been appointed to this position. It is said that he has been a successful business man and is connected with one or two financial institutions and is an active politician. At the time of his appointment he was a member of the board of election commissioners, an institution peculiar in Boston, I believe. What special qualifications are claimed for him that would call for his appointment I have not heard. If it is on account of his financial ability, surely in a department whose annual expenditures amount to $60,000, 94 per cent. of which is for fixed salaries, the payment of $5,000 for the proper disbursement of $3,600 is rather high priced financiering. But little has been heard of him in his new position up to August 3d, when the following item appeared in the Boston papers:

"Wire Commissioner Kennedy, who has been pestered for months by the Democratic leaders to make changes in his department, has at last yielded, and to-morrow three new men will report to take the places of the three removed. The new appointments are Patrick J. Heffernin, Patrick F. Hopkins and William Hogarty. The first named was for several years an official in the water department, and he was one of the many who had to retire when Mayor Hart took the reins more than two years ago. Mr. Hopkins is a well-known ward 17 Democrat, and Mr. Hogarty has been prominent among sporting men, and is a close personal friend of John L. Sullivan. Other changes are looked forward to in the city collector's office and the wire department during the coming week."

It will be noticed that these men are to take the places of others removed, and that no attempt is being made to reduce the force that is costing at least 50 per cent. more than it should; and that the changes have been made to please the Democratic leaders rather than for the benefit of the public. The fact that one was formerly connected with another city department and was removed by a Republican mayor, and that the other is a well-known Democrat of Ward 17, will be sufficient evidence to satisfy the Democratic leaders as to their qualifications for any position in the wire department; but to find the true reason for the appointment of the person who has been "so prominent among sporting men and is a close friend of John L. Sullivan," ex-champion pugilist of the world, is a difficult problem for you and me. Perhaps the better way would be to write direct to Commissioner Kennedy who would no doubt give such convincing reasons that you would not rest until you had secured the services of some intimate friend of some one of the many eminent exponents of the manly art to assist you in the performance of your duties. In the absence of the Commissioner's lucid explanation, it may seem strange that appointments of this kind can be made with the sanction of a mayor who, in a public speech which he journeyed to New York to make, declared that "there was one corner of the earth where the civil service law would be respected." To be sure, he has said many other nice things, but "actions are far more eloquent than words."

Mr. Marconi on the Wireless Telegraph Conference.

On his recent arrival in London, Mr. Marconi was interviewed as to the proposed wireless telegraph conference, when he said: "To my mind the promoters of the international convention have not a sufficiently accurate knowledge of the subject with which they propose to deal to put forward any propositions of value. To be candid, I regard the proposed convention as neither more nor less than another attack by Germany upon British industry. It is probably thought in Germany that as matters stand wireless telegraphy is at present too much in favor of England. The general interests of navigation are not so much considered there as the local interests of Germany. The British and Italian navies have adopted my system, and there is none other in use in the mercantile marine of the world. I do not wish to place myself in antagonism to Germany or any other country. I wish to serve all alike, but as to Germany, the facts are these: Prof. Slaby came to England and was introduced to me by the British Post Office authorities. He came at the instance of the German Government to study my system of wireless telegraphy. He received every facility from me to do this. He went back to Germany. He lectured there, declaring that he himself had attempted experiments in wireless telegraphy which had proved unsuccessful. He had seen what Marconi was doing, which represented a real invention, and he admitted that whatever he did in the future would be due to Marconi, his master. He adopted the essential features of my system—vertical wire for transmitting and receiving, for instance. These are the main features of his system. He introduced some other variations which I consider detrimental—indeed, experiment proves them to be so. He has established a so-called system of his own, by which he has telegraphed one-twentieth of the distance I have covered. The German manufacturers who have no inventor's royalties to pay are prepared to sell their inferior apparatus for a small manufacturing profit. It is the desire of the German Emperor, I presume, to support them in this undertaking, and this it is which has inspired the demand for the convention. I think that a convention might at the proper time be a good thing, but the time is not ripe for international consideration. It is better to let fair competition work out its natural results. You cannot well yoke my system to an inferior and unsuccessful imitation. The attempt is to place inferior imitations on terms of equality with the original system."

Washington, Baltimore and Annapolis Single-phase Railway.

We are requested to say that the engineers of the Washington, Baltimore and Annapolis Railway are the Cleveland Construction Company and not the Cleveland Engineering Company, as printed in the paper on this railway recently read before the A. I. E. E.

CURRENT NEWS AND NOTES.

A FUNNY SWISS STRIKE.—A curious street railway strike occurred recently at Geneva, Switzerland, owing to some difference between the employees and the American manager. The road was built by Mr. Stephen D. Field, the well-known American engineer, with the aid of English capital. Sympathetically, all the union labor in Switzerland was called out, but it did not go. The government has intervened firmly, and the fuss seems to be over.

THE OHIO ELECTRIC LIGHT ASSOCIATION, which meets this week at Columbus, Ohio, is to discuss, among other things, the questions connected with meters; the present development of steam turbines; methods for improving load curve and net earnings; hot-water and steam heating as adjunct services, and the reliability, regulation, efficiency, power factor, etc., of alternating-current series arc-lighting apparatus. A number of well-known names are attached to these topics.

WEST INDIAN CABLE.—Repairs to the St. Lucia-Grenada cable were completed on October 10. The cable was lifted from about 2,000 fathoms of water, and, owing to the fact that it was buried in volcanic mud, the strain was very great. The cable used in the repair work is valued at between $25,000 and $30,000. The Lord Mayor of London, Sir Marcus Samuel, has donated $3,750 from the Mansion House Relief Fund to aid the families of the crew of the cable repair steamer "Grappler," which was lost, with all on board, last May, as a result of the eruption of Mont Pelée.

TESLA FINED.—On Tuesday of last week, Mr. Nikola Tesla was fined $100 by Judge Foster, of the General Sessions in New York, for failing to appear as a talesman on the jury panel for the court of that term. Next day Mr. Tesla appeared before the judge and obtained a remission of his fine, and also got an extension of time until October 16. As to his failure to report for jury duty, Mr. Tesla explained that the summons was overlooked because he had been absorbed in some very important work on Long Island. "When I become absorbed in my work," he said, "I forget everything else."

CHICAGO ELECTRICAL ASSOCIATION.—The next five papers before the Chicago Electrical Association are as follows: October 17.—"The Place of Correspondence Schools in Electrical Education," by Harris C. Trow, instructor in electrical engineering, American School at Armour Institute of Technology. November 7th.—"The Development of a Small Alternating-Current Motor," by H. I. Finch, superintendent, Emerson Electric Manufacturing Company, of St. Louis. November 21st.—"The Electrical Features of the Aurora, Elgin and Chicago Railway," by Howard Brooks, assistant electrical engineer of the above road. December 5th.—"The Early Development of European Incandescent Lamps," by Capt. A. de Khotinsky, late managing director of incandescent lamps factories, at Paris, France; Rotterdam, Holland; Gelnhausen, Germany, and Marlboro, Mass. January 16.—"The Third-Rail System for Electric Railways," by H. M. Brinkerhoff, general manager, Metropolitan West Side Elevated Railway Company.

AMERICAN ELECTROCHEMICAL SOCIETY.—At a meeting of the directors of the American Electrochemical Society, held at Philadelphia, October 2, 1902, the following applicants for admission to membership were elected: Halbert K. Hitchcock, Floreffe, Pa.; Robert A. Witherspoon, Niagara Falls, N. Y.; Edwin J. Murphy, Lynn, Mass.; G. A. Burr, Etzatlau, State of Jalisco, Mexico; Mrs. M. J. Reed, Philadelphia, Pa.; John P. Jackson, State College, Pa.; Willard E. Case, Auburn, N. Y.; Arthur E. Gibbs, Niagara Falls, N. Y.; J. C. Roberts, Niagara Falls, N. Y.; G. G. Herbert, Detroit, Mich.; W. O. Snelling, Union City, Pa.; Max M. Haff, Niagara Falls, N. Y.; Samuel Weil, Niagara Falls, N. Y.; Edwin J. Houston, Philadelphia, Pa.; Lewis E. Saunders, Niagara Falls, N. Y.; George W. Fletcher, Brooklyn, N. Y.; Ernst J. Berg, Schenectady, N. Y.; Isaiah L. Roberts, New York; Wesley S. Block, New York; Henry Arden, San Francisco, Cal.; Oscar Pickering, Cleveland, Ohio; Ray Hill White, Niagara Falls, N. Y.; Loren R. Vorce, Cleveland, Ohio. These admissions bring the membership of the society to 414.

PARIS UNDERGROUND ROAD.—The Paris Metropolitan Underground Railway, says a special cable dispatch, has been running more than two years, but has never paid a dividend, though the shares are steady at nearly double their par value. Though only a short line from the Porte Maillot to Vincennes, it has killed one large omnibus line, and in seven months has carried over 32,000,000 passengers. The first extension from the Etoile to the Place Blanche, along the line of the outer boulevards, is now complete, and opens tomorrow. This brings a very important new current of traffic from the northwest to the east, and may double its receipts.

FROST WARNINGS BY ELECTRIC LIGHTS.—It is proposed to use electric light signals at night and flags by day to warn the fruit growers of the Santa Clara Valley as to the approaching weather conditions. Prof. A. G. McAdie, of the Weather Bureau, at San Francisco, has suggested that during the months of February, March and April the orchardists be warned by colored lights of the approach of frosts, which would enable them to smudge by burning oil, etc. During September, October and November the approach of showers could be indicated. An electric tower, 220 feet in height, located in San Jose, Calif., can be seen over the greater part of the county.

THE PACIFIC CABLE.—A special dispatch from Victoria, B. C., of October 6, says: The cable steamship "Colonial," the largest cable vessel on the seven seas, to-night completed her epoch-making work in laying the longest section of cable in the two hemispheres. The Bamfield Creek to Fanning Island stretch of the "All Red" British Pacific cable is completed from the station on the Vancouver Island coast to within 175 miles of the British Isle. The "Colonial" has dropped 3,540 miles of cable, all of which is now imbedded in the ooze of the Pacific. When the last reports were flashed to Bamfield Creek by the operators on board the ship, there were but 180 miles more to lay—not a day's work.

SCHOOLHOUSE TELEPHONES.—Telephones for each of the New York public schools are suggested by Commissioner Nathan L. Jonas. Fire protection is the principal reason urged, it being pointed out that many schools are not equipped with alarms. Mr. Jonas says the plan was first suggested by a request from the City Superintendent for a telephone for each of the district superintendents and by the statement that the Brooklyn schools were unprotected. He said that the system, with a central office in the Board of Education building, could be installed for $52,512, or much less than the cost of connecting all of the schools by fire alarms, and that the system could be used for other emergencies. City Superintendent Maxwell does not believe telephones necessary, and does not favor the plan.

INDIANA MUTUAL TELEPHONE COMPANIES.—The managers of the Mutual Telephone Company, of Shelby County, Ind., met in Shelbyville, Ind., October 4 and effected an organization for the purpose of securing uniformity of rules and regulations calculated to better the service to the patrons. A fee of 5 cents will hereafter be charged to everyone using a telephone belonging to these companies who is not a subscriber. It was asserted that telephone service in the county was too free; that improvements and new appliances are necessary, and money must be provided to procure them. The following gentlemen were elected officers of the new association: M. A. Theobold, of Morristown, president; C. E. Pile, of Marietta, vice-president; Perry Harris and Lewis Creek, second vice-presidents; William Emsminger, of Blue Ridge, treasurer; D. B. Wilson, of Shelbyville, secretary. The association will hold monthly meetings.

THE NEW YORK ELECTRICAL SOCIETY will open its 1902-1903 season on Wednesday, October 22d. This, the 227th meeting of the society, will be held, by courtesy of the American Institute, in the lecture room of the Institute, at 19 West Forty-fourth Street. Mr. Charles R. Pratt will lecture on "Electric Elevators." The lecture will comprise a brief history of electrical elevators, the present state of the art, and what is being done towards developing a high-speed electric elevator. The lecture will be freely illustrated with lantern slides. President Sheldon has appointed the following committees: Finance—H. A. Lardner, chairman; G. Herbert Condict. Membership—W. S. Barstow, chairman; C. O. Baker, Jr., Willard S. Bennett, Reginald Pelham Bolton, E. H. Mullin and C. L. Wilcken. Examining—H. V. A. Parsell, chairman; W. I. Donshea. Reception—Hobart D. Betts, T. C. Martin, H. A. Sinclair, G. H. Guy. Papers and meetings—G. H. Guy. There are already a large number of applications for membership to be presented at the opening meeting. The society commences this season under highly favorable conditions, both as to membership and finances.

LETTER TO THE EDITORS.

Proposed Electrical Units.

To the Editors of Electrical World and Engineer:

Sirs.—In reading the editorial in your issue of September 27th, on the system of electrical units which formed the subject of a paper read by the writer at the Niagara Falls meeting of the American Electrochemical Society, I note you say that the system is "based upon the coincidence that 500 amperes flowing for one day will liberate almost exactly one cubic meter of hydrogen, which will weigh almost exactly one pound." Permit me to correct this statement by saying that it is the 100-ampere current for one day, or the kilocrith col, which will liberate the cubic meter of hydrogen. The 500 amperes or the pound col is that which will liberate within 0.59 per cent. of a pound avoirdupois of hydrogen.

Since the discussion of the paper, I have secured from Dr. Edward Morley the atomic weight of silver with hydrogen as unity, based upon his determination of the weight of one litre of hydrogen. The figure thus given for the atomic weight of silver is 107.11, somewhat lower than the figure which I used. Accepting this figure as being very nearly correct, I find upon calculation that the pound col or 500 amperes for one mean solar day lacks just 0.59 of one per cent. of freeing one pound avoirdupois weight of hydrogen. The kilocrith col, or 100 amperes for one mean solar day, liberates 0.34 of one per cent. in excess of that necessary to fill the cubic meter. Calculating the hydrogen freed by 100 amperes for one siderial day, or for one true revolution of the earth on its axis, the cubic meter is almost exactly filled there being an excess of only 0.07 of one per cent.

Independent of the electrolytic current, I have noted the following striking agreement, which points to some kind of a connection, if it is not pure accident, between the number of seconds in a mean solar day and the mass of a cubic litre of hydrogen. The three values in the second column below are the values of gravity at the north pole, at 45 degrees latitude, and at the equator. It will be seen that, dividing 86,400 seconds in a mean solar day by these values, as a mean result we secure, to within 2.4 parts in 10,000, the weight in dynes that one litre of hydrogen will show if weighed with a spring balance at the three places named:

Seconds in mean solar day.		*Value of gravity.*		*Weight in dynes of one litre of hydrogen.*	
86,400	÷	983.11	=	87.884	
86,400	÷	980.61	=	88.108	Mean result.
86,400	÷	978.1	=	88.334	
Grammes in weight litre of hydrogen.					
.089873	×	983.11	=	88.355	
.089873	×	980.61	=	88.130	Mean result.
.089873	×	978.1	=	87.905	

In the foregoing we have used the three values of gravity in both instances, as it better enables studying the agreement, but it is with the mean value of gravity which determines the mean pressure of the atmosphere that we have to deal, as the litre of hydrogen at the mean pressure of the atmosphere and at zero C. weighs, as Dr. Morley has found, .089873 — .000027 grammes. It can be shown that if the two figures in the above, 88.108 and 88.130 were in perfect agreement, then if the weight of a litre of hydrogen were multiplied by the square of the mean value of gravity, the resultant figure would be 86,400, the number of seconds in a day. The result actually obtained from the above is 86,421.5 seconds, thus showing a variation of 21.5 seconds from exact agreement. It is to be noted, however, that the limits of possible error in Dr. Morley's determination are sufficiently great to be outside of this variation. Hence, it cannot be known at the present time whether the agreement is absolute, unless some demonstration can be made, proving that such an absolute agreement is a necessary consequence of the magnitude of the various C. G. S.

units involved in their relationship to the mass of the earth and the mass of unit volume of the gas, hydrogen, which is unity in the table of atomic weights. The specific gravity of hydrogen with water as unity of specific gravity is represented by the figure .000089873, hence, this odd number is the one which enables the conversion of the specific gravities of all gases with hydrogen as unity of specific gravity, to their specific gravities with water as unity, and the relationship above pointed out therefore naturally reaches to all elements and compounds in chemistry when their atomic and molecular weights are taken into consideration.

Should this relationship prove to involve absolute agreement, it is interesting to note that the number of seconds in a mean solar day, divided by the weight in dynes of a litre of hydrogen, gives us the value of gravity at 45 degrees latitude and sea level, or, again, the value of gravity is equal to the square root of the quotient of the number of seconds in a mean solar day, divided by the weight in grammes of a litre of hydrogen, and that these ratios could be substituted for g in the ordinary equations for the values of velocity, space, time and energy where the value of gravity is involved. Hence it is, if this connecting link can be proven fundamental, the periodic law in chemistry, the law of gravitation, and probably Coulomb's law of attraction between electrical bodies can probably all be brought within the scope of some broader generalization.

Cleveland, Ohio. Alfred H. Cowles.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Utilization of Materials in Dynamo Design.—S. P. Thompson.—A British Association paper, in which he discusses the specific utilization of the materials in relation to the armature; a small armature requires, of course, only a small field magnet; Mavor has introduced the conception of the "active belt," meaning by this term the entire mass of the peripheral structure of the armature down to the roots of the armature teeth, and consisting of iron, copper and insulation. It is in this active belt that the whole inductive generation of e. m. fs. takes place; and it is also on this active belt that the whole of the mechanical forces, as between armature and field, are exerted. Mavor discussed the energy spent in this active belt, and in order to obtain figures that could be compared with one another for different machines, he calculated the relation between the output of the machine and the volume of the active belt, not under the actual conditions of use, but on the supposition that in all machines the field was equally strong and the peripheral speed alike; *i. e.*, he ascertained, for a number of different machines, the number of ergs per second per cubic centimeter of active belt at unit velocity in unit field; this number, although varying from one machine to another, was found to be about 5. This measures simply the current density (or the number of c. g. s. units of current per square centimeter) in the cross section of the active belt; as 10 amperes per square centimeters, or 3⅔2 amperes per square inch. The present author extends this conception of the active belt still further, and considers not only the mean number of amperes that traverse each square inch of it parallel to the shaft, but also the mean number of magnetic lines that traverse each square inch of it radially; and at the same time he considers the speed with which it moves forward tangentially. He gives some formulas, and shows that the power in watts per cubic inch is a product of three factors. The first factor is the gross current density per square inch axially in the active belt. The second factor is the gross magnetic density per square inch "radially" in the active belt. The third factor is proportional to the peripheral velocity. He has made a detailed analysis of some 50 modern direct-current generators, of sizes above 50 kw, with slotted armatures. If these three factors are taken for any particular machine, one has at once a means of comparison between its design and that of other machines, in respect to the specific utilization of the materials. Some of the numerical results are given. By multiplying those three factors for any machine, one gets its specific output in watts per cubic inch of active belt. In the machine considered, the value of this varies between 45 and 120 watts per cubic inch. But in one case the value runs down to 15 watts per cubic inch, though the machine is by a first-class maker; and in one case the figure rises to the value of 192 watts per cubic inch. This machine is the 1,600-kw generator described by Hobart before the Glasgow Engineering Congress. A high peripheral speed, and a high degree of saturation of the iron teeth conspire to give this machine a remarkably great output in proportion to its size and weight.—Lond. *Elec.*, September 19.

Lights and Lighting.

Conduction in a Nernst Lamp.—Bose.—A paper on the electrolytic nature of the process in the Nernst lamp. He attempts to explain the curious fact that a Nernst lamp will burn hundreds of hours with direct current which should theoretically electrolyse it in about five minutes. He assumes that in the oxides which make up the conductor, the velocity of migration of the cations is probably very much smaller than that of the anions. Hence the chief part in the current conduction is probably taken by oxygen ions, while the metallic ions in a stationary state undergo no displacement. The oxygen evolved at the anode diffuses back to the cathode in the interior of the rods, and there oxidizes the metal again. The oxygen of the air which surrounds the rod and also penetrates into it, encourages the process and leads to the well-known increase of durability of the lamp as against its behavior in a vacuum. The following observations confirm this theory. In a vacuum the rod gradually assumes a darker hue and a metallic aspect, which disappears on exposure to air. The vacuum around the glowing rod can never be carried as far as it can when the rod is cold.—*Ann. d. Phys.*, No. 9; abstracted in Lond. *Elec.*, September 26.

Power.

Limits of Power Transmission.—An article on the physical limits of electric power transmission, which are fixed by the voltage used. The pressures developed in the armature coils of alternators must reach their higher limits at a point much below 50,000 and 60,000 volts. In the largest transmissions with alternating current there is, therefore, no prospect that step-up and step-down transformers can be dispensed with. In none of these instances where transformers are working at 40,000 to 60,000 volts is there any indication that the upper limit of practical voltage has been reached; on the contrary, transformers have repeatedly been worked experimentally up to and above 100,000 volts. He then discusses the line construction and gives some numerical data. He calls attention to the fact, demonstrated at Telluride, that with 47,300 volts on each line the leakage per mile between the two wires 15 inches apart was 10 times as great as the leakage between the two wires 52 inches apart; he concludes that leakage through the air may be reduced to any desired extent by suitable increase of distance between the wires of the same circuit. But to carry this very far involves radical changes in line construction, as it seems to involve the use of a separate pole for each wire of a circuit, the wire to be mounted at the top of its pole. This construction calls for three lines of poles to carry the three wires of a three-phase transmission. Each of these poles may be of only moderate dimensions, say 30 feet long with 6 or 7 inch top. The cost of three of these poles will exceed by only a moderate percentage that of a 35 or 40 foot pole with an 8 or 10 inch top, such as would be necessary with 12-foot cross-arms. The distance between these poles at right angles to the line may be anything desired. Extra long pins and insulators of the umbrella type at the pole tops will easily give a distance of two feet or more between the lower wet edge of each insulator and the wood of the pin or pole. Such line construction would probably safely carry two or three times the maximum voltage of present practice.—*Eng. Mag.*, October.

Power Equipment of Manufacturing Plant.—An illustrated article on the power equipment of the new works of the British Westinghouse Company, at Trafford Park, Manchester, where actual manu-

facturing has just commenced. The power supply is by alternating currents. The generating plant contains four three-phase generators, two of 750-kw each and two of 250-kw each, the voltage being 440, and the frequency 25. There are also two exciters and a rotary converter, giving 550-volt direct current for special purposes throughout the works, such as for certain testing, for arc lighting, etc. There are other converters in the testing department. Practically the whole of the power is developed by induction motors with squirrel-cage rotor, running direct on the 440-volt supply circuit. The motors are used direct coupled or belt connected to independent machine tools. —Lond. *Elec. Rev.,* September 12.

Power Plant in North Wales.—An illustrated description of the hydro-electric power plant near Blaenan Festimiog, in North Wales. The company gives a 24 hours' supply, providing power to slate mines and quarries for hauling, pumping, mill driving, etc., and also electric light for the streets and for private consumers of the town. Direct current is supplied at 500 volts for power purposes, and at 230 volts for lighting, heating and small motors. The company has taken the pumping by contract, which enables it to supply power for this purpose, at the most convenient times to itself, for equalizing the load on the generators, and consequently the load factor is good. Motors are at present connected to the mains to the extent of 400 hp, and 3,000 lamps of 8 cp. There are two 560-volt, 90-kw, direct-current generators, and a battery giving 140 ampere-hours if discharged in one hour. In the town the voltage is reduced to 230 by means of a motor-generator.—Lond. *Elec. Rev.,* September 12.

Steam Turbines.—Parsons.—A brief abstract of a British Association paper. The largest steam turbine of the Parsons type made so far is of some 5,000 hp; he discussed especially the use of steam turbines in the mercantile and naval marine, and also mentioned its use as a reversed apparatus, *i. e.,* as a rotatory pump for water or for compressing air. In the discussion, Crompton stated that electrical engineers would welcome the steam turbine as a pump, inasmuch as it gives them a high-speed rotary pump which they can couple directly with an electric motor. Replying to an inquiry as to the use of superheated steam in turbines, Parsons stated that the approximate improvement in economy of heat is one per cent. for each 10 degrees of superheat, up to 200 degrees superheat. One of the difficulties in the use of very high degrees of superheat is the unequal expansion of the turbine chamber when the steam is turned on.—Lond. *Elec.,* September 19.

REFERENCES.

Large Gas Engines.—Humphreys.—An abstract of a British Association paper on recent progress in large gas engines. Gas engines of 1,200 hp and 1,500 hp are already working, and others of 2,000 hp to 4,000 hp are being constructed. He gives data on several manufacturers which show that there has been rapid progress. The future of the gas engines for central station purposes depends on the ability of gas engines to drive alternators in parallel. Numerous instances were given in which gas-driven alternators are regularly at work in parallel, giving good results.—Lond. *Elec.,* September 19.

Hydro-Electric Plants.—De La Brosse.—The first of a series of illustrated articles on hydro-electric plants in the Alps. After some general introductory notes the Rhone power house at Jonaga is described.—*The Elec. Age.,* October.

TRACTION.

Electrolysis by Return Currents.—Larsen.—An account of experiments in which he investigated the question of how far the electrolysis of gas and water pipes by return currents of tramways can be diminished by changing the direction of the current at regular intervals. Two sets of tests were made; in one, the direction of the current was reversed once every hour, in the other once every day. The results seem very promising, for by reversing one a day the electrolytic action is reduced to one-fourth, and by reversing once an hour it is reduced to one-thirtieth. Moreover, if the direction of the current is always the same, the result of electrolytic action is that holes are eaten into the pipes, while with the current reversals the reduced electrolytic action which is still left is distributed more uniformly with considerably less bad effects.—*Elec. Zeit.,* September 25.

Some more experimental investigations by the same author on the same subject. Each of nine pieces of iron or steel tubes, 2 inches in diameter, was placed vertically in the center of an iron cylinder, 10 inches in diameter; each of these cylinders with its tube rested in an upright position on an insulating clay plate, and the space between the cylinders and tubes was filled with earth. Direct current was sent from the tubes to the outside cylinders, all these different "cells" being connected in series. The results show that the loss of weight per ampere-hour was practically the same under the different conditions of the experiments, and was independent of the current density, the voltage, the kind of iron, the percentage of sodium chloride and of whether the circuit was continuously closed or periodically interrupted.—*Elek. Zeit.,* September 18.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

British Central Station.—An illustrated article on the lighting station of Stamford, which has a population of 8,000. So far 3,000 lamps of 8 cp have been installed, and 4,000 more have been applied for. There are two steam-driven, 480-volt, 90-kw, direct-current dynamos, supplying a three-wire system. The balancing is effected in the usual way by means of rotary balances and boosters. There is a storage battery of 260 cells, giving 350 ampere hours.—Lond. *Elec. Eng.,* September 19.

ELECTRO-PHYSICS AND MAGNETISM.

Velocity of Light in an Electrostatic Field.—Fessenden.—A brief communication. Some time ago he drew the theoretical conclusion that the velocity of light should accelerate in an electrostatic field. In preliminary rough experiments made by him, he now finds that this is indeed the case, although the velocity actually observed is only 80 per cent. of that predicted by him. He also mentions briefly that by a development of his vortex theory, the difference between positive and negative electricity can be explained. The difference is said to be merely one of circulation, *i. e.,* the simple vortex "singularity" is to be taken as the negative electron, and when a number of the vortex "singularities" are so grouped that their circulation is closed, they behave as positive electrons. Hence the positive electron is simply an agglomeration of negative electrons, so grouped as to have a closed circulation.—*Science,* September 19.

Positive Electrons.—W. Wien.—A German Bunsen Society paper, in which he gives an account of a long series of experiments in which discharges in vacuum tubes were made with perforated cathodes; the positive electrons which travel towards the cathode pass through its perforations and can then be investigated in the same way as the negative electrons in cathode rays, etc. He used the method applied by Kaufmann for his researches on Becquerel rays. The results obtained by the author concerning positive electrons differ greatly from those formerly obtained for regular electrons. For the positive electrons the ratio of mass to change varies greatly; it may be that the gas ions themselves are the positive electrons, but this is not yet sure. While the negative electrons in cathode rays maintain the same ratio of mass to change all along their path, the positive electrons change this ratio along their path; it is possible that they gradually combine with negative electrons, so that their positive charge is gradually neutralized. Differences in the color of the fluorescence produced make it possible that chemical influences take part in the phenomena.—*Zeit. f. Elektrochemie,* August 14.

Radioactivity.—J. J. Thomson.—A long editorial on a recent lecture held before the British Association, on Becquerel rays and radioactivity. It was the Röntgen ray which first gave the clue to the true action of uranium and other phosphorescent bodies, and it was Becquerel who first followed up this clue. His experiment is described, which conclusively proved that the radioactive emanations were self-originating and independent of any previous influence on the radioactive material. He made experiments showing the dis-electrification by the presence of radioactive matter, and discussed the work of Prof. and Mrs. Curie. Three special radioactive substances have been detected: radium, polonium and actinium. Of these, polonium and actinium have never been obtained in a sufficiently high degree of concentration to make their presence visible in the spectroscope. Only by the evidence of radioactivity can their existence be detected. The radioactivity test is "millions of times more sensitive than chemical analysis, and thousands of times more sensitive than the spectroscope." The percentage of radioactive matter in many substances in which these properties have been detected is "far less than the percentage of gold in sea water." In the case of pure radium, matter is being thrown off so slowly by radioactivity that it would occupy one square centimeter of surface a million years to throw off only one-thousandth of a milligram of the substance. On the other hand, the energy thrown off is at a far

more rapid rate, being sufficient within the million years to melt a layer of ice a quarter of a mile thick. It remains yet to be explained how the radium maintains its supply of intrinsic energy. Placed in contact with barium or thorium—or, indeed, with almost any substance—a piece of radium will gradually impart to the neighboring substance its own radioactive properties, and will itself lose those properties; if now the two substances be separated for a time, it will be found that the barium will gradually lose the properties which contagion has imparted to it, while at exactly the same rate, the depleted radium will restore itself to its normal radioactivity; the explanation is still a mystery.—Lond. *Elec.*, September 19.

Generation of Röntgen Rays.—Tommasina.—An article in which he formulates the following novel view of the formation of Röntgen rays. The electric flux starting from the anode follows the lines of electric force, forming its own conductors, which consist of polarized alignment of radiant matter, as is the case in the production of electric phantoms of conducting powders in liquid dielectrics. The flux being of an oscillating character gives rise to a periodical destruction of the contacts, and this produces vibrations which become visible in the form of luminescence. The cathode is not the only source of cathode or X-ray, as these may also be generated at the walls of the tube, and generally at any point where the anode flux is reflected. It is not necessary, as alleged by Semenov, that the anti-cathode be insulated. Cathode rays can be produced in a conical tube in which an electrode is placed at the top of the cone, and another in a side tube, by joining the former electrode to the positive pole of an induction coil through a water resistance, and leaving the other electrode and the other pole insulated. This would apparently mean that the impact of positive ions is sufficient to elicit negative ions and produce Röntgen rays. The production of the latter, which require a high velocity of impact, could hardly be due to the impact of slow positive ions.—*Comptes Rendus*, August 11; abstracted in Lond. *Elec.*, September 19.

Dimensions of Cathode Phenomena.—Hehl.—An account of an investigation of the dimensions of the different cathode layers under various circumstances, *i. e.*, of Goldstein's first, second and third cathode layers which are now known as the canal rays, the Hittorf or Crookes dark space, and the negative glow light. The most characteristic quantities in a vacuum discharge are the cathode drop, which is independent of the pressure, but dependent upon the gas and the metal, and the current density existing when the cathode is incompletely covered with light.—*Phys. Zeit.*, September 1; abstracted in Lond. *Elec.*, September 12.

Atmospheric Electricity and Earth Currents.—Walker.—An article in which he gives a summary of various observations made by others and himself, and discusses the various causes which have been suggested for the earth currents. He remarks that it is not impossible that on the mountains, where the effect of solar radiation is greater in the less dense atmosphere, the ultra-violet rays may modify the earth's negative charge to a greater extent than at low elevations, and produce the result that is manifested in the earth current. As these rays must fall in different phases at different places, there would also be present the conditions favorable to extensive electrical eddies in the air—Lond. *Elec.*, September 12.

Pyromagnetism and Piezomagnetism.—Voigt.—A discussion, from the point of view of the electron theory, of the question whether the phenomena of pyro-electricity and piezo-electricity have magnetic analogies. He comes to the positive conclusion that such magnetic analogies actually exist, though they are probably very small. He is engaged in a systematic search for crystals showing the new magnetic properties. So far, the results have been practically negative.—*Ann. d. Physik.*, No. 9; abstracted in Lond. *Elec.*, September 12.

Solar Protuberances and Terrestrial Magnetism.—Sir N. Lockyer.—An account of an investigation in which he reaches the following conclusions: The epoch of magnetic storms classed by Ellis as "great" and those of the greatest chromospheric activity of the sun near its poles are identical. The general curve of terrestrial magnetic activity is nearly the same as that of the protuberances near the solar equator.—*Comptes Rendus*, August 25; abstracted in Lond. *Elec.*, September 12.

Electro-Chemistry and Batteries.

Electrolysis of Alkaline Chlorides with Platinized Platinum Anodes.—Foerster and Mueller.—A German Bunsen Society paper, giving the results of a long experimental investigation. The average e. m. f. required for the electrolysis of alkaline chlorides is smaller for platinized platinum anodes by 0.5 volt than for bright platinum. The formation of the chlorate is about the same, although it starts somewhat later at the platinized anode than at the bright platinum, and the platinizing of the anode is of influence only upon the electrolytic processes preceding the formation of the chlorate. They made a very long investigation of the causes of this influence of the platinizing of platinum. The difference of voltage between the electrolysis with bright and with platinized platinum anode depends upon the nature of the electrolyte and more or less upon the current density; with sodium hydroxide and sodium chloride it also changes considerably with the time.—*Zeit. f. Elektrochemie*, July 31.

Formation and Disintegration of Alloys at Cathodes.—Haber.—A paper in which he first makes some theoretical remarks on the potential of electrodes of alloys; they have a certain distinct potential difference against an electrolyte, which can be calculated theoretically. In the second part he gives a general review of the phenomenon of the pulverization of metallic cathode; the special case treated by him is a simple, purely electrochemical one. At a cathode in an alkali solution an alloy of the cathode material with the alkali metal is formed electrochemically, and has the property of being decomposed in water or aqueous solution with a simultaneous pulverization. This has long been known to be the case for mercury cathodes, but it is also the case for lead and tin. Alloys which pulverize contain a relatively high percentage of the alkaline metal, while alloys with a lower percentage decompose water quietly, without pulverization, but with a formation of a sponge on the cathode get a spongy surface; there is a great difference in this case between surface. Some metals, especially platinum, do not pulverize, but get a spongy surface; there is a great difference in this case between acids and alkalis.—*Zeit. f. Elektrochemie*, August 7; a brief reply, by Billitzer, to some critical remarks of Haber, in *Zeit. f. Elektrochemie*, August 28.

Electrolytic Copper Refining.—Philip.—The conclusion of his long serial on the financial basis and design of electrolytic metal refineries. The increase in the current density is not only limited by the question of prime cost, interest and depreciation, but also by other important factors, such as the alteration of the mechanical character of the electro-deposited copper and the alteration of its chemical nature. Unless some special means are used, the copper which is deposited with current densities much above, about 14 or 15 amperes, per square foot, tends to take a chrystalline and loose form, and if the electrolyte contains many impurities the high current density is favorable to the precipitation of arsenic and antimony with the copper. Economy in copper is attained by using all the vats in series, and having the vats as large as possible. The amount of copper is also less the greater the current density. He finally makes a few remarks on the size and the number of the vats, and on the voltage of dynamos for copper refining.—Lond. *Elec.*, September 26.

Electrolytic Preparation of New Alloys.—Coehn.—A German Bunsen Society paper. Ammonium, like sodium, can be deposited on a mercury cathode, and then forms an alloy, but it was impossible to get an ammonium deposit with a cathode of wood metal. He tried to deposit alloys of light and heavy metals from aqueous solutions by depositing both metals at the same time from the solution. It has been repeatedly stated that the electrolytic deposition of nickel can be improved if a magnesium salt is added to the solution; he believes it is because an alloy of nickel and magnesium is deposited; pure nickel does not adhere firmly, while a nickel magnesium alloy does. He tried to obtain in the same way an alloy of aluminum and magnesium, but was not successful.—*Zeit. f. Elektrochemie*, August 14.

Electrolytic Production of Soda and Chlorine.—Glaser.—An account of laboratory experiments, in which he investigated the Solvay-Kellner mercury cathode process on a small scale. The principal results are as follows: A low ampere-hour efficiency is mainly due to the depolarizing action of the chlorine on the alkali amalgam; the decomposition of water is of less importance. A good efficiency can be obtained only at high-current densities, when no diaphragm is used. With specially prepared diaphragms the efficiency is good also at lower-current densities.—*Zeit. f. Elektrochemie*, August 7.

References.

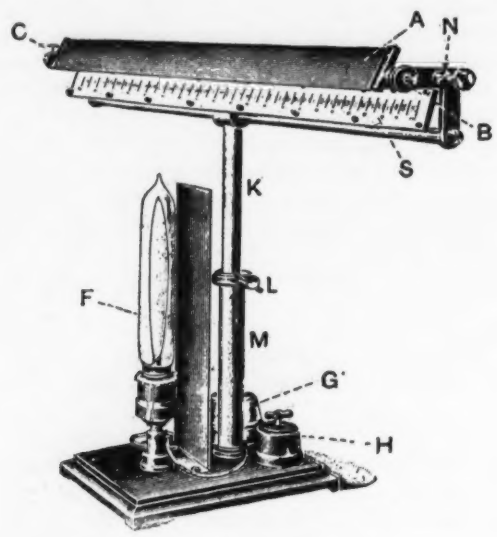
Chlorates.—J. B. C. Kershaw.—The first of a series of illustrated articles on the electrolytic manufacture of chlorates. After

some introductory notes on the reactions and their equations, the Gall and Montlauer chlorate cell and the Carlsen chlorate cell are described.—*Elec. Rev.*, October 4.

Rotation of Layers of Sulphuric Acid and Water in a Magnetic Field.—Urbasch.—A reply to Drude's critical remarks, in which he maintains the correctness of his observations and also makes some remarks on Nernst's diffusion theory.—*Zeit. f. Elektrochemie*, August 7.

Units, Measurements and Instruments.

Objective Readings.—Edelmann.—An illustrated description of a new arrangement to give objective readings. While the spot of light is superior to the reading telescope, as it enables several observers to take readings at the same time and to be less straining to the eye, it has the disadvantage that it requires a dark room, and that the observer's head is often in the path of the beam. With translucent scales the reading is indefinite and depends upon the point of view. In the author's arrangement these drawbacks are



APPARATUS FOR OBJECTIVE READINGS.

eliminated and all the advantages of the objective reading retained. In the adjoining diagram, *M* is a column in which the rod *K* can be moved up and down and fixed by *L*. It carries the celluloid scale, *S*, loosely hung in it, and is finally adjusted by the screw *N*. The mirror, *A*, is turned at *B* and fixed at *C*. The lamp is an incandescent lamp, *F*, with a thin central filament and thicker lateral filament. The latter does not glow, and the glowing filament thus provides a single straight line. *H* is a switch, and *G* an insertion key. The scale is read from the other side, through the mirror, and no darkening of the room is necessary.—*Phys. Zeit.*, August 15; abstracted in Lond. *Elec.*, September 26.

Silver Voltameter.—Farup.—An illustrated description communicated by Nernst, of a new form of silver voltameter, which while facilitating the weighing, is in general just as exact and considerably more exact when very small currents are used. The solution consists of about 10 grams of silver nitrate and about 15 grams of cyanide of sodium, dissolved to 100 cc. of solution. With this electrolyte it is absolutely necessary to exclude oxygen, for if the oxygen of the air finds access, a silver plate will dissolve considerably in a solution of cyanide of sodium. The principle feature of his apparatus consists in keeping the oxygen away from the platinum cathode by means of properly arranged sheets of silver. In order to remove all the oxygen originally in the electrolyte, it is necessary to set up the voltameter for some time before the circuit is closed. The weighing of the silver is done in the ordinary way; at the end of the test, the platinum electrode is weighed without any other care, except that it is cleaned in distilled water and dried for a few seconds over a flame.—*Zeit. f. Elektrochemie*, August 14.

Telegraphy, Telephony and Signals.

Hollow Conductors in Wave Telegraphy.—Turpdin.—An account of an investigation of the effect of using hollow conductors, both as regards protection from penetrating waves and concentration of waves inside of them. An exciter was enclosed in a box lined with tin, about 25 cm. square. A receiver, comprising a coherer, a relay and a bell and battery, was enclosed in a similar box. Each box had a circular hole, 14 mm. in diameter, through which a conductor was introduced, consisting of a bare wire, a tube, or a leaded cable, 10 meters long. When the transmitter and receiver are both completely enclosed, no action between them is possible. Also, when the holes are open and are jointed across by a metallic tube, no action is noticed. But when the tube enters the boxes without touching the tin, or when the boxes are removed, a decided response is seen. In these cases the tube appears to concentrate the waves upon the receiver. The action is still better when a cable with metallic covering is substituted for the tube. In this case the core of the cable joins the two pieces of apparatus, and the leaden wrapping serves to concentrate the waves. This concentrating action is not impaired by peeling off a short length of the leaden wrapping, so long as there is no metallic connection between the core and the portion of the wrapping attached to the receiving box. If the other portion of the wrapping is connected with the core, it makes no difference. These observations give hints with regards to Hertzian wire telegraphy; the metallic wrapping of every submarine or subterranean cable should be continued right up to the transmitter and receiver. Each of the latter should be contained in a hollow conductor connected with the metallic wrapping. Under these conditions a powerful concentration of the electric waves is obtained, which would be impossible if the waves passed from the core to the metallic wrapping of the cable at the point where the cable commences. Beyond that point the waves would be dissipated in the ground or in water. The experiments may be utilized also for wireless telegraphy. The author proposes that both transmitter and receiver should be enclosed, and joined to the air wire by means of a cable with metallic wrapping. The experiments show that no inconvenience is caused by connecting the wrapping of the transmitter cable to the air wire itself. As regards the receiver, a connection between the cable wrapping and the air wire would constitute a very effective and convenient protection of the receiver against waves emitted from the station. This connection could be interrupted when receiving.—*Comptes Rendus*, September 8; abstracted in Lond. *Elec.*, September 26.

Miscellaneous.

Presidential Address.—Dewar.—A reprint of his long presidential address to the British Association, a large portion of which deals with a summary of recent very low temperature researches, including some resistance determinations.—Lond. *Elec.*, September 12, 19.

New Book.

Die Internationalen Absoluten Masse Insbesondere die Electrischen Masse. Fuer Studirende der Electrotechnik in Theorie und Anwendung Dargestellt und Durch Beispele Erlautert. By Dr. A. von Waltenhofen. Braunchweig: Friedr. Vieweg & Son. 306 pages, 42 illustrations. Price, 9 marks.

The science of electricity was fortunate in that most of the quantities involved in it could not be measured in feet and pounds, and therefore a new system of units had to be evolved; and, thanks to the continental foreigners, who realize the advantages of a rational system of units better than we or the English do, that new system was made a rational one, and was based on the absolute system. It is not strange therefore that the absolute and the electrical systems of units should naturally be treated of together, even though the former are separate and distinct by themselves. That this well-known and distinguished author has included both, with special reference to electrical units, is, therefore, not unreasonable, especially as the absolute systems are more closely related to the electrical than to the others. But there does not seem to be an equally good reason for enlarging the book to nearly double the number of pages of the second edition, to include an "introduction" to electricity. The latter had better have been a separate book, as that subject has been treated in many other books, while there are few thorough books—as this one is—on the absolute systems.

In this third edition the author has revised and enlarged the sections on electrical and magnetic units with special reference to the applications of electricity, including such subjects as permeability, the predetermination of dynamo characteristics, efficiency, current and voltage of dynamos, etc. which latter do not really belong to a treatise on units. Another section treats of the theory of poten-

tials. Another is on galvanometers. The section on self-induction has been revised and enlarged, but the greatest additions have been made in the parts on the theories of alternating currents, including polyphase and oscillatory currents. The sections on the transmission of power, calculation of lines, heating of wires, etc., have also been enlarged slightly. The book is primarily for students of electricity, but is intended also to be a reference book for physicists and electrical engineers. While it seems to accomplish the first object, we cannot say the same for the other, as a reference book should be practically complete, which that part is not.

The first part, comprising less than a third of the book, is a thorough, systematic, and apparently very good treatise on the various sytems of units, divided into mechanical, magnetic, electrostatic and electromagnetic, with the absolute systems as a basis common to them all. While he mentions several absolute systems based on the millimeter, centimeter or kilometer, yet they are all mass, length and time systems; and we regret to see that he does not seem to have included some of the other interesting absolute systems which have been suggested, based on other fundamental measures, such as energy, force, etc., some of which are not without their advantages.

We are pleased to see that he specifically states that the time unit called the second which is used in all these systems, is the mean solar second and not the sidereal second, which latter is really the more rational for a fundamental unit; but the solar second being the one indicated by our time pieces, was wisely given the preference for practical reasons. Whether it is the solar or the sidereal second that is used in the absolute system seems to be very rarely stated in books, even by careful writers. The difference between the two is quite appreciable. We are also pleased to see that he shows clearly that the loosely used term energy is synonomous with work, and does not include power, as is often supposed.

It is to be regretted that he is not accurate with his constants, which he gives to only a few places of figures. Nor does he give tables of equivalents. One would have expected to find very accurate and full tables of equivalents in such a book. The kilogram moreover is said to be the weight of a cubic decimeter of water, which might have been explained in such a book as this, in a foot note, to be only approximately correct though sufficiently so for most purposes. The exact relation is still to be determined by experiment, as it is not fixed by theoretical relations as many suppose, owing to the unfortunate way in which the international kilogram was defined. Nor is the meter really an exact decimal fraction of an earth's quadrant, as he claims. There is an inexcusable error in his definition of our ton weight which is not the same as our obsolete ton capacity measure, as he states it to be.

The second part, comprising about two-thirds of the book, may be said to be a treatise on electrical and magnetic calculations from the academic standpoint, including both the highly theoretical ones and to some extent the practical ones. The general contents of it have already been noticed above as the newer additions to the third edition. It seems to be somewhat unbalanced in that some subjects are discussed at length while others are either not considered at all or only briefly. If its purpose, however, is only to serve as various examples in electrical calculations, it seems to do well what it is intended for.

It is to be greatly regretted that the author, or perhaps the publisher, insists upon the use of the old style German type which well deserves the name of eye-poison. Most scientific books in German are wisely printed in the Latin type, or what might now be termed the international type. All Germans can read both, but few outside of Germany read the old German type. It is a pity that this distinguished author has thus restricted the use of this book, and has classed himself with the Chinese, Japanese, Russians and some savage tribes, in using national instead of international letters.

Directory of Electrical Societies, Etc.

American Institute of Electrical Engineers, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Next meeting Oct. 24, paper by C. P. Matthews on "An Integrating Photometer for Glow Lamp and Sources of Like Intensity."

National Electrical Contractors' Association of the United States, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

National Electric Light Association, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

Northwestern Electrical Association, Secretary, Thos. R. Mercein, Milwaukee. Wis.

Ohio Electric Light Association, Secretary, J. H. Perkins, Youngstown, Ohio. Next meeting, Columbus, Oct. 14, 15 and 16, 1902.

Old-Time Telegraphers' and Historical Association, Secretary, John Brant, 195 Broadway, New York.

Pennsylvania State Street Railway Association, Secretary, John Ruth.

The Electrical Trades Society (member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Vermont Electrical Association, Secretary, C. C. Wells, Middlebury, Vt.

Electrostatic Ground Detectors.

An electrostatic ground detector has been recently placed on the market by the Fort Wayne Electric Works, which is very simple in construction, and is claimed to possess many features not found in other instruments. In theory, also, it differs somewhat from other ground detectors.

In all types of electrostatic ground detectors the principle of the

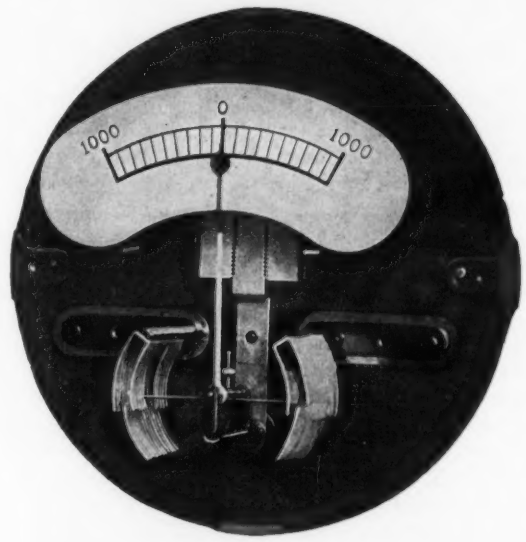


FIG. I.—MECHANISM OF GROUND DETECTOR.

electrostatic voltmeter is employed, the deflecting torque being created by the attractive force between electrically charged surfaces. In most single-phase ground detectors the line terminals are connected to two plates, or two sets of plates, which are stationary, while the movable plate or vane is connected to earth. When no ground exists, the movable member is attracted equally by the two stationary parts connected to opposite sides of the line, but as soon as one side of the line is connected to earth, or grounded, the partial neutralization of the charges on the movable vane and the grounded line produces an unbalanced condition between the attractive forces of the two stationary plates and the movable vane, and causes a deflection of the pointer attached to the vane toward the grounded side. The amount of the deflection indicates the strength of the ground, a direct ground throwing the pointer to the limit of its motion in the direction of the grounded side, while a leakage or partial ground is indicated by a slight deflection.

In the Fort Wayne single-phase electrostatic ground detector, the line terminals are connected to stationary members composed of sheet aluminum, stamped and pressed into a shape not unlike a double rake with curved pointed teeth. The charge produced by the line potential is concentrated on these points according to a well-known law of electrostatics. The movable member consists of two similar sets of points carried on opposite ends of an arm mounted on a shaft

set in jewel bearings. These points are free to move in or out between the double sets of stationary points. The moving parts are in no way connected to the circuit, but receive their charge from a set of points that are charged by another group directly connected to the earth. A delicate torsion spring connects the shaft to these stationary points, and together with light adjustable weight on the shaft maintains the pointer at zero position under normal conditions.

The application in this instrument of the theory of the concentration of an electric charge at a point makes practical the use of an extremely light moving part, which is still further lightened by making it of aluminum. The result is a sensitive instrument whose accuracy is permanent since wear on jewels or shaft is inappreciable.

FIG. 2.—GROUND DETECTOR.

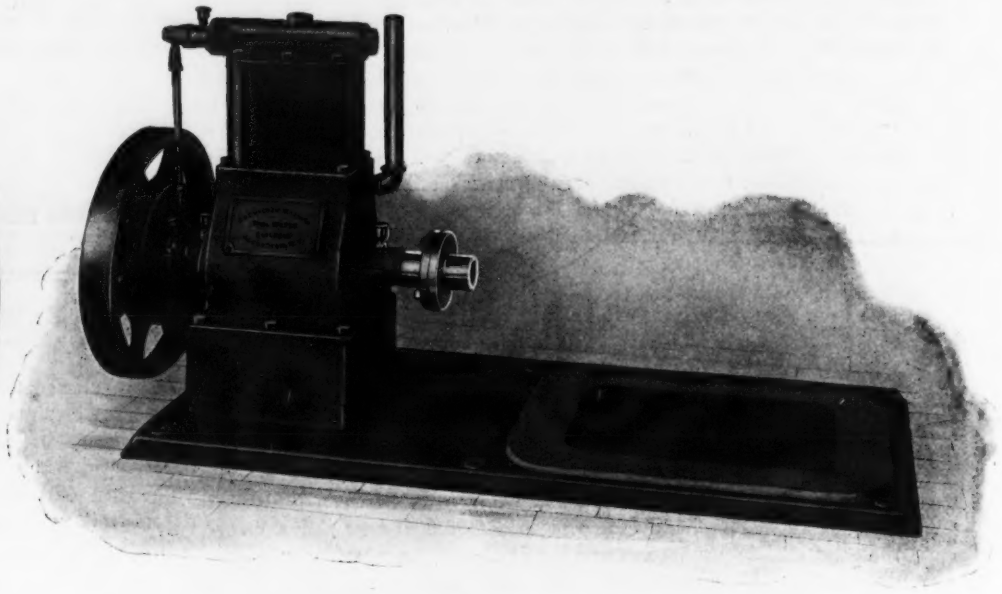
The entire mechanism of the instrument is rigidly mounted on and thoroughly insulated from a solid metal base, which is designed for mounting on switchboards. The cover is easily removed without disturbing the adjustment or connections, which are all made from the back. The scale is silvered brass mounted in the top of the case, similarly to other round switchboard instruments. The middle of the scale is the zero, or "no-ground" position of the pointer.

The instrument is connected permanently in circuit through graphite sticks carried on hard rubber insulators mounted on a marble base designed for mounting on the back of the switchboard. The resistance of these graphite sticks is sufficient to protect the instrument and the circuit from accidental grounds or short-circuits within the instrument itself.

These ground detectors may be used on two or three-phase circuits, two instruments being required in either case. For two-phase, two-wire circuits, two ground detectors and two sets of three graphite resistances are employed, while but one set of four resistances and two instruments are necessary for two-phase, three-wire or three-phase circuits.

Acme Automatic Engine.

The Rochester Machine Tool Company, Rochester, N. Y., is manufacturing a small type of automatic engine especially adapted for direct connection to electrical generators, one of which is shown in the accompanying illustration above. The engines are manufactured from ½ to 8-hp on the basis of 100 lbs. steam pressure, though they are built strong enough for a working pressure of 200 lbs. It is claimed that the engines run smoothly at any speed from 100 to 800 r. p. m. and regulate to within 2 per cent from no load to full load. The governor, as will be seen, is of the fly wheel type and is claimed to be extremely sensitive. These machines are particularly applicable for work in connection with small independent units for use at times when it is not practicable to operate the main plant, or when repairs are being made. Among the applications named are installations in office buildings, night service in hospitals, running search lights, etc.

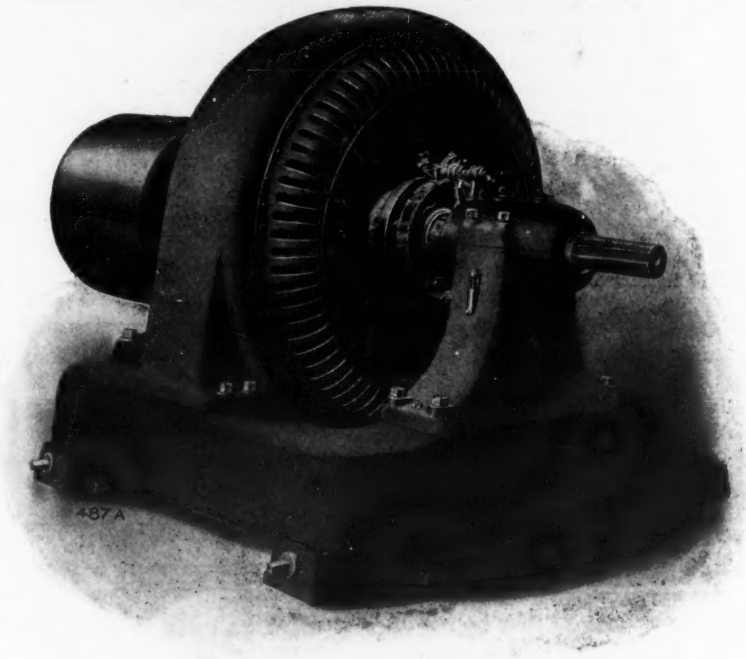


ACME AUTOMATIC ENGINE.

"Ceco" Alternators.

In the issue of last week appeared an account of some of the direct-current machinery manufactured by the Christensen Engineering Company, of Milwaukee, and we give below a description of the type of alternator made by the same firm. All the "Ceco" alternators, whether belted, engine type or direct coupled are of the revolving field type, thus leaving the armature stationary and easily accessible. By this form of construction the difficulties of properly insulating the armature coils which have caused much trouble in rotating armatures are eliminated.

The frame consists of cast-iron housings, into which rings of laminated steel with inwardly projecting teeth are assembled, thereby forming slots for receiving the armature windings. The armature is designed with six slots per pole, so that it may be wound or rewound for single, two or three-phase as required. The armature frames for the belt-driven alternators are cast in one piece, while the



250-KW THREE-PHASE "CECO" ALTERNATOR.

frames for the direct-driven machines are divided horizontally. Instead of the usual practice of having several coils for the same machine, all the armature coils for each "Ceco" alternator are of the same size and shape so that they are interchangeable. The coils are specially insulated, so that they will stand without injury the highest temperature that will ever be reached in service.

The poles are built up of laminated steel upon a cast-iron spider,

which is mounted upon a forged steel shaft. In the large sizes the laminated poles are assembled upon a steel ring which is carried on the shaft by means of the cast-iron spider. The individual poles are in all cases easily removable with their coils, without dismantling the machine. The field coils are composed of rectangular copper strap bent on edge. The collector rings are made of cast-iron, and carbon brushes are used, thus reducing to a minimum the tension required, as well as the wear of the parts. Standard frequencies are 60 and 25 cycles per second. With the exception of the smaller sizes, "Ceco" alternators can be wound for any voltage up to 15,000. The temperature rise when running continuously with full load at any power factor will not exceed 35° C. in the armature of 40° C. in the fields. At 25 per cent. current overload the corresponding temperatures will not exceed 40° C. and 50° C. The machines are all designed so that they will carry satisfactorily a 50 per cent. current overload for two hours at any power factor without injurious heating.

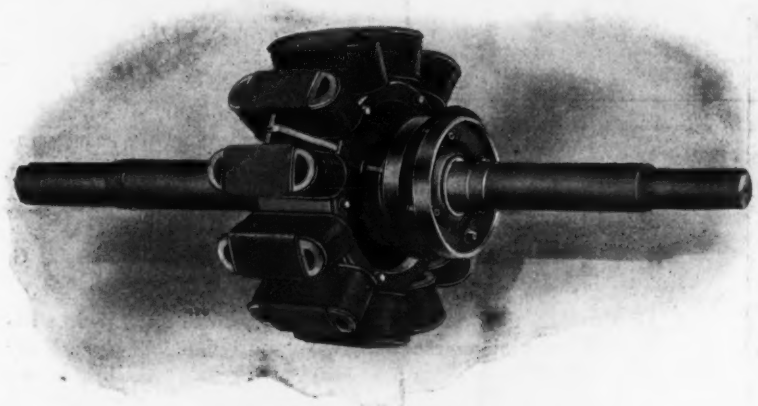


FIG. 2.—REVOLVING FIELD FOR "CECO" ALTERNATOR.

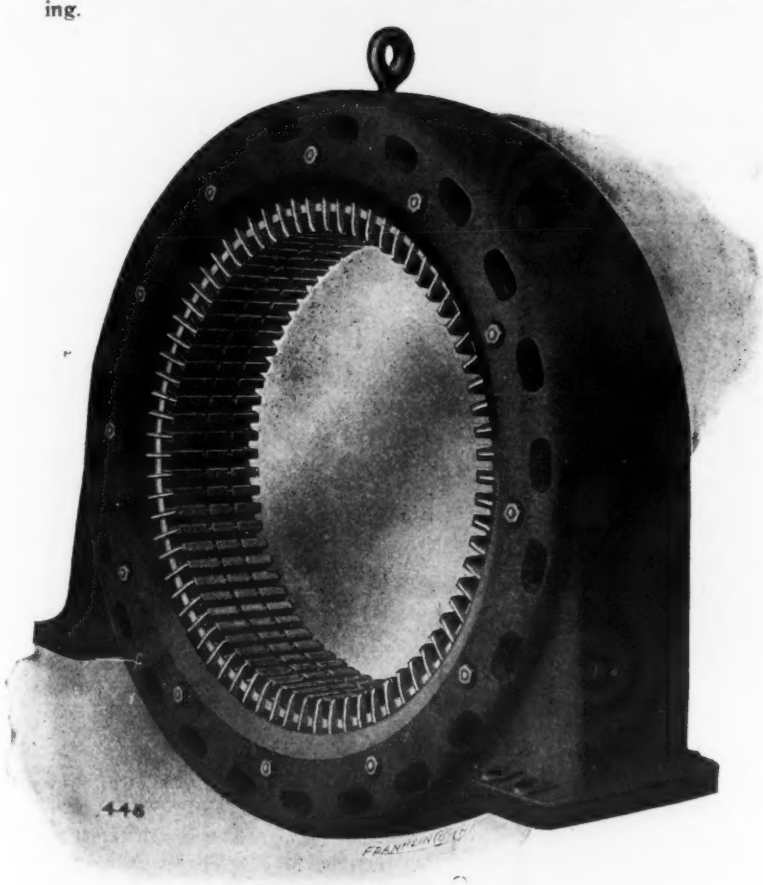
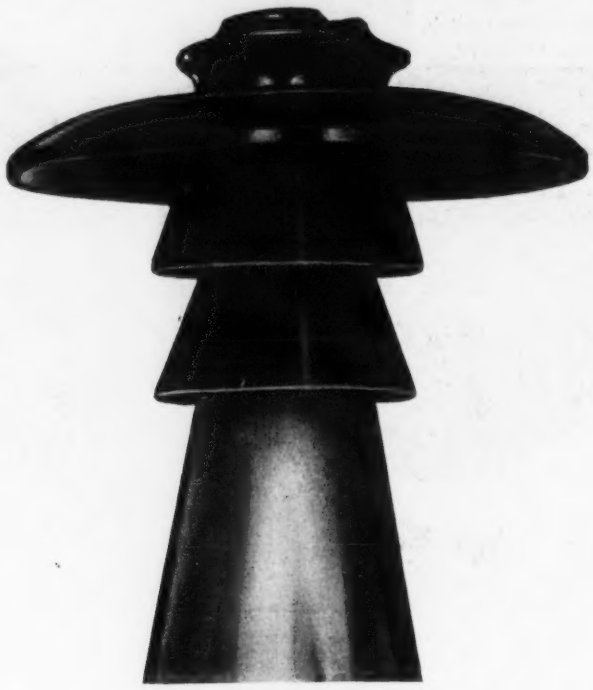


FIG. 3.—ARMATURE FRAME FOR ENGINE-TYPE "CECO" ALTERNATOR.

The present works of the Christensen Engineering Company were completed but two years ago, and no expense was spared in providing every facility for the rapid, accurate and economical manufacture of its product. The equipments of machine tools, cranes, special machines, etc., is unusually extensive, modern and complete. The foundation for a 250-foot extension to the main machine shop, which is 186 feet in width, has just been completed. There are three stories, and this extension will provide 88,000 additional square feet of floor space.

High-Voltage Insulator.

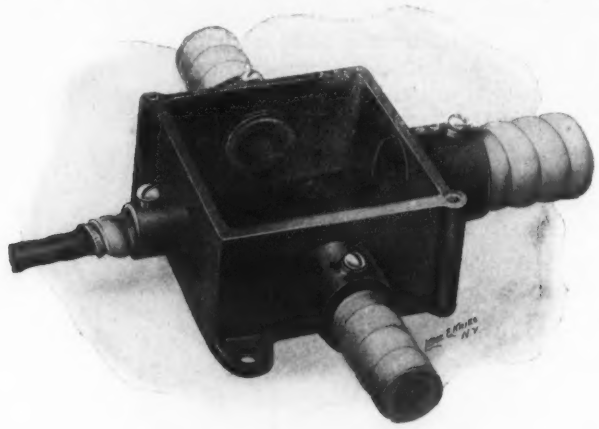
Fred M. Locke, of Victor, N. Y., has recently brought out a modified type of high-voltage insulator, illustrated herewith. This insulator is somewhat similar to that shown in a recent issue, but is slightly higher, and is provided with three petticoats, as shown in the engraving. It is 14 inches across the hood. This insulator has been tested up to 160,000 volts, and is made for any voltage up to 100,000 volts line pressure.



HIGH-VOLTAGE INSULATOR.

Junction Box.

The accompanying illustration shows a junction box, manufactured by the Sprague Electric Company, which contains four different sized fittings. This box meets a requirement that arises when it becomes necessary or desirable to use different sizes of flexible metallic conduit or cable, or both, and will be appreciated by wiring contractors The fittings may be placed as desired when the order is accompanied by a sketch showing their sizes, number and location.



JUNCTION BOX.

Echoes of the Street Railway Convention.

The proceedings of Friday, the last day of the American Street Railway Convention, at Detroit, are noted elsewhere in this issue. Our special supplement brought the proceedings down to the morning of that day, and included a large number of notes on various exhibits and well-known firms, etc., represented. Below are given a few further items of interest of the same character:

Porter Railway Switch Company, Detroit, had an ingenious "electrical operator," for trolley tracks. It will supply an unlimited amount of current to the car while the trolley is resting on the 3-foot brake in the trolley wire, and is furnished in conjunction with a Porter rocker switch.

EXHIBIT OF GENERAL ELECTRIC COMPANY.

Detroit Trolley and Manufacturing Company, through its president, Mr. W. S. Macdonald, showed an ingenious form of trolley base, with 50 one-inch steel balls running in two races, and giving remarkable ease of sweep to the motion of the trolley pole, while thus facilitating its steadiness of contact with the trolley wire.

Pneumatic Railway Equipment Company, of Cleveland, exhibited in working order their ingenious device, called the "air electro trolley control," by which electro magnets working on valves of an air chamber will throw the pole clear of the wire or assist in its prompt restoration. It is under the instantaneous control of the motorman. It can be cut-out when desirable, leaving the pole to be handled freely around a car barn, and it rotates freely on a swivel point. The device is, indeed, very ingenious, and was shown in operation by Messrs. Robert C. Beebe and G. R. Tomb.

Dearborn Drug and Chemical Company, of Chicago, had an exhibit of their lubricating oils and greases, and barrels of their "solution" for boiler treatment. Their specialties in this line are too well known in the electrical field to need discussion here. The company distributed souvenirs, including, for the ladies, bottles of perfume from their Dearborn laboratories. They were represented by Messrs. R. F. Carr, W. B. McVickar, G. W. Spear and Otto Flugel.

American Steel and Wire Company had a fine display in the main hall of their conduits and cables, trolley wires, line material, fencing for right of way, rail bonds, etc., all artistically disposed; while overhead was a name sign carrying nearly 400 incandescent lamps. The company distributed a neat leather pocket-book, and were represented by Messrs. C. S. Knight, Jr., F. A. Keyes, T. A. Sheppard, G. Chandler, W. C. Bogue, W. H. Van Sicklen and H. T. Pratt.

The Union Switch and Signal Company, represented by Mr. T. H. Patenhall, showed an equipment of its electric staff instruments for block systems on high-speed electric railways.

Chase-Shawmut Company were represented by Mr. Frank D. Masterson, who distributed a handy little pamphlet of electrical data. He represented the Chase-Shawmut flexible rail bond, which has a soldered contact giving high conductivity, and of which the installation cost is small.

Creaghead Engineering Company, of Cincinnati, had an interesting exhibit of their overhead line material, their Bourbon strain insulator and their Creaghead incandescent lamp. The company were represented by Mr. A. E. Payne.

Dallett & Co., of Philadelphia, distributed literature in regard to their various electrical supplies and specialties.

Stromberg-Carlson Telephone Manufacturing Company had an exhibit of their well-known apparatus. Their system is in use on the interurban roads around Detroit.

American Arithmometer Company, of St. Louis, made an interesting and timely exhibit of their ingenious and beautiful Burroughs adding machine.

Westinghouse, Church, Kerr & Company were represented by Mr. Carl M. Vail, their energetic young secretary and treasurer. The Michigan woods are full of trolley systems carried out under W. C. K. direction.

H. B. Camp Company, noted briefly last week, had an interesting display in the smoking room of their well-known vitrified clay conduit, in single and multiple duct, for electric railway and other service. They were represented by Messrs. H. H. Camp and C. C. Baird.

Nungesser Electric Batteries were represented by Mr. T. G. Grier, of Chicago, who had an exhibit of them in the gallery.

R. D. Nuttall Company, of Pittsburg, Pa., exhibited their well-known gears and pinions, especially those for high-speed work. They showed also their trolley stands. They were represented by Messrs. F. A. Estep, G. W. Provost and A. S. Partridge.

Union Mica Company, of New York, were represented by Mr. Albert Korst, and had on hand an exhibit of its mica board, flexible mica varnish cloth, mica segments, rings for motors, generators, etc.

Crocker-Wheeler Company, of Ampere, N. J., organized on Thursday afternoon, a most interesting trolley trip to the Rochester power house on the Flint Division of the United Railway Company, of Detroit. Two well-filled cars were dispatched about 2:30, under

NATIONAL CARBON COMPANY'S EXHIBIT.

the direction of Messrs. Putnam A. Bates and F. B. De Gress, and a delightful ride of some 30 miles was made out into the pretty rural region lying back of Detroit, illustrating to the fullest extension the manner in which the trolley has banished isolation for the farmer and brought all the comforts and conveniences of the remote city to his very door. Not only were passenger cars flying in every direction up and down rural lanes, but at frequent switches were freight and express cars, laden with goods or with farm produce, from fresh milk to the last bushel of husked corn. The Rochester plant, 26 miles out, recently illustrated in these pages, might well be called a Crocker-Wheeler railway power house. It contains a fine 400-kw Crocker-Wheeler generator, driven by Ball & Wood compound condensing engine and two 200-kw Crocker-Wheeler

units, similarly driven. Circuits radiate widely from this plant, and the sterling stability of the apparatus is evidenced by the continuous overloading to which it has been subjected for months in meeting

KELLOGG TELEPHONE EXHIBIT.

the demand for current. During the trip cigars and dainty descriptive bulletins were served out, while at the power house, sandwiches, coffee and punch refreshed those who had been enjoying the spin through the crisp autumnal air.

Mr. C. G. Curtis, the inventor of the Curtis steam turbine now exciting so much attention, arrived to listen to the discussion on the general turbine question, and returned immediately to New York.

The Stuart-Howland Company, of Boston, Mass., had an exhibit of their overhead trolley specialties in a parlor at the Cadillac Hotel. The exhibit included their overhead brackets and other forms of their overhead suspension for single and double trolley. They made an exhibit also of their rib trolley wheel, and distributed a souvenir medallion, which was an exact facsimile of it. The company were represented by Messrs. H. W. Smith, of Boston, and H. De Steese, of New York.

The McRoy Clay Works, of Brazil, Ind., were represented by Mr. E. F. Kirkpatrick, the Chicago manager. This company made no exhibit, but had among the delegates present a great many customers for their conduits for trolley mains and feeders.

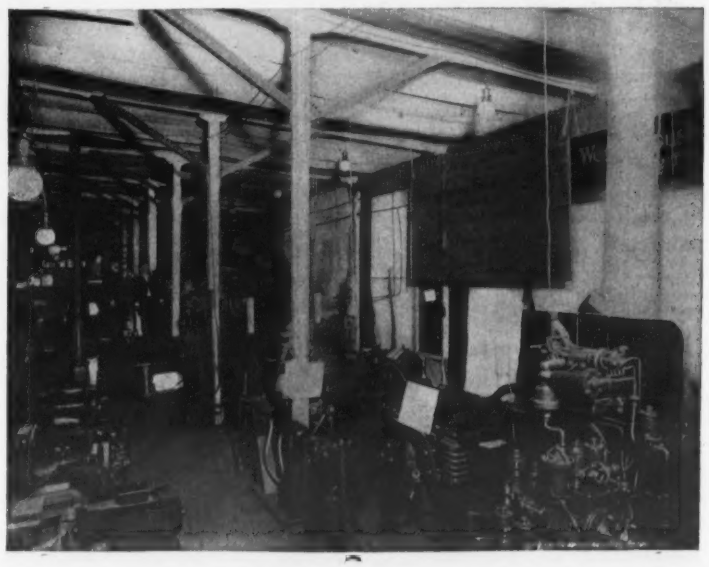
The J. G. White Company, of New York City, were represented by Mr. C. G. Young, who returned not long since from the Philippines, and Mr. H. S. Collette, representing also the San Juan Light and Power Company, of Porto Rico. The White interests were represented also by Mr. S. G. Averell and Mr. E. L. West.

Maltby Lumber Company have yards near Detroit for their well-known pole business, whence they supply many street railway companies, as well as other concerns in the lighting, telephone and telegraph field. Visits to the yards were made by trolley and launch.

Samson Cordage Works, of Boston, were represented by Mr. F. J. Coakley, the specialties of this concern having as many friends and patrons in the trolley field as in that of lighting.

Westinghouse Electric and Manufacturing Company had a splendid exhibit of apparatus, the most prominent item of which was a 1,500-kw rotary converter of standard type, which was not erected when the convention began. The ease with which installation was completed and the machine set in operation induced the belief that the tardiness was in reality intentional, in order to give the company a plausible opportunity to show how readily the apparatus could be set up and operated. It was certainly a striking performance. Another notable exhibit was the set of multiple control apparatus, consisting of sets of controllers, etc., for two cars, and four motors, all arranged on Baldwin trucks for demonstration. The exhibit of motors embraced various small and large types for urban, suburban and long-distance work. There was also an exhibit of induction motors and transformers. Much attention was also bestowed by delegates on the display of detail apparatus such as starting resistances for cars, canopy switches, automatic car circuit breakers; overload circuit breakers, iron fuse blocks, lightning arresters, and voltmeters and ammeters. The exhibit was indeed one of the most complete and effective that a great manufacturing company has ever sent to a street railway convention. Appropriate literature was distributed, and a large staff was on hand to conduct the exhibit, etc. The company were represented by Vice-President F. H. Taylor, W. M. Probasco, L. A. Osborne, Arthur Hartwell, W. H. Whiteside, C. E. Skinner, A. Whitley and J. M. Duncan, of Pittsburg; T. P. Gaylord, C. W. Regester and Irvin Dryer, of Chicago, and C. B. Humphrey, R. E. Drake, C. W. Underwood, W. E. Parker, Geo. B. Dusinberre, F. B. H. Paine, J. R. Gordon, R. S. Brown, N. S. Braden, D. D. Pendleton, B. T. Brady, H. B. Shute, N. W. Storer, S. W. Kier,

Exhibits of Gould Storage Battery Company, American Steel and Wire Company and H. W. Johns-Manville Company.



WESTINGHOUSE EXHIBIT.

H. P. Davis, P. N. Lincoln, C. Renshaw, H. N. Cheny, C. F. Medbury, W. B. Wriaks, M. Baxter, J. L. Crouse.

LUDLOW SUPPLY COMPANY had an exhibit which included the specialties of the Crouse-Hinds Electric Company and the "automotoneer" of the Garton-Daniels Company; also the Morris Electric Company, and the Johnson "trolley retractor."

NATIONAL LEAD COMPANY, whose exhibit was noted last week, included in their display during the convention a bearing lined with their Phœnix babbitt, which had been in continuous service on the Detroit United System since August, 1901, and which was going right back into service as soon as the convention was over. It was an astounding exhibit of ability to stand hard work without any perceptible wear. There were also a number of other bearings that had been in steady use and had been removed only in order that they might be exhibited at the convention and then restored to the apparatus.

ELECTRIC STORAGE BATTERY COMPANY.—One of the most interesting exhibits was that of the Electric Storage Battery Company, of

A GROUP OF PROMINENT EXHIBITS.

Philadelphia, manufacturers of "the chloride" accumulator. This company had on view several standard types of their railway cells, in lead-lined wooden tanks and in glass jars. The capacity of the former cell is 2,600 amperes at the hour rate, of the latter cell 240 amperes at the hour rate. Several samples of vehicle types of the exide battery were also on exhibition. Two standard blue Vermont marble switchboards, of the type commonly erected by the Battery Company, were also installed, showing the special apparatus used in connection with railway installations. One of the most interesting features of this exhibit was the special differential type railway booster. Besides this exhibit on the floor of the Armory, the company referred, as part of their display, to the three batteries on the system of the Detroit United Railway. The first of these batteries consists of 276 cells installed opposite the main power house of the system. This battery has been in daily operation for the past two years, and by absorbing fluctuations on the system, greatly reduces the daily engine hours. Its capacity is 2,500 amp.-hours at the hour rate, which capacity is fully utilized once every day on the peak of the load. The second battery consisting of 250 cells is located about two miles from the power house at the corner of Hancock Avenue and Third Street. Its capacity is 2,200 amp.-hours at the hour rate. It is operated in connection with a standard differential type booster. It is used on the peak of the load once or twice a day, as conditions demand, to maintain the proper voltage within a radius of a mile from the battery house. Before this installation was made, a variation in voltage of even 100 volts occurred, the pressure on the peak dropping as low as 375 volts. After installing this battery a voltage variation of from 480 to 500 was the maximum. The third battery on this system is located about eleven miles from the power house, on the Wyandotte Division, at Ecorse. It consists of 276 cells, of a capacity of 240 amp.-hours at the hour rate. This battery is used as a regulating line battery, in connection with a booster operated at the power house end of the line, a feeder running direct to the battery and the line being fed by feeders from this point. Before the installation of the battery, the pressure of this division varied between 200 and 750 volts. The pressure of this division is now maintained between the limits of 550 and 600 volts, enabling them to better maintain schedules as well as materially reducing the maintenance cost of the electric equipment of the cars. The Electric Storage Battery Company was represented by Charles Blizard, manager, sales department; J. Lester Woodbridge, engineer, sales department; E. Vail Stebbins, manager, Cleveland office; G. H. Atkin, manager, Chicago sales office; R. H. Klauder, manager, St. Louis sales office; R. B. Daggett, manager, San Francisco sales office, and J. E. Lockwood, president, Michigan Electric Company, the Detroit agent of the Electric Storage Battery Company. A booklet describing the plant of the Detroit United Railway Batteries and several other installations was distributed by the Battery Company during the convention.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money closed at 9 per cent. for 60-day loans. The unsettled condition of the stock market continued throughout the week, owing to continued high rates for call money and the lack of loans on time, even at very high figures. Speculative buying power was absent, although the reports of progress toward a settlement of the coal strike caused a rally on Thursday; the market, however, receded on account of the uncertainty about the results, and closed dull. In Boston, General Electric closed with 8¼ points off, and American Telephone and Telegraph 3½ points. Tractions and electrics in the New York market were all weak and lower in sympathy with the general condition of the market. Brooklyn Rapid Transit closed at 61⅞, a net loss of 2⅛ points. Metropolitan Street Railway reached 140½, but receded to 136½, which was the closing quotation as well as the lowest of the week, this being a net loss of 2½ points. General Electric closed at 177¼, after having reached 182½. The closing quotation represents a net loss of 7¾ points, and was also the bottom figure of the week. Westinghouse lost 5½ points net, closing at 211½, which was a rally of 2½ points from the lowest price, 214 being the highest. Western Union fluctuated between 92 and 90⅛, closing at 90⅜, this representing a net loss of 1⅞ points. American Telegraph and Telephone lost 4 points net, closing at 163½, which was ½ point above the lowest quotation of the week, 164 being the highest. Other closing quotations were: American District Telegraph 38½, a net loss of ½ point, and American Telegraph and Cable 95, a net gain of 1 point. Following are the closing quotations of October 14:

NEW YORK.

	Oct. 7.	Oct. 14.		Oct. 7.	Oct. 14.
American Tel. & Cable.	92	92	General Electric	180	181
American Tel. & Tel..	165	163	Hudson River Tel.....	108	—
American Dist. Tel....	36	37	Metropolitan St. Ry...	136½	138
Brooklyn Rapid Transit	61½	62	N. E. Elec. Veh. Trns..	—	—
Commercial Cable	—	—	N. Y. & N. J. Tel....	160	—
Electric Boat	23	23	N. Y. E. V. T. Co....	12½	12¼
Electric Boat pfd.....	35	35	Tel. & Tel. Co. Am..	—	—
Electric Lead Reduc'n..	2¾	3¼	Western Union Tel....	90¾	90⅞
Electric Vehicle	—	4	West. E. & M. Co.....	200	210
Electric Vehicle pfd....	10	9	West. E. & M. Co. pfd.	210	210

BOSTON.

	Oct. 7.	Oct. 14.		Oct. 7.	Oct. 14.
American Tel. & Tel..	163½	163½	Western Tel. & Tel. pfd.	98½	—
Cumberland Telephone .	—	—	Mexican Telephone	2⅛	2
Edison Elec. Illum....	275*	—	New Eng. Telephone....	139	135
Erie Telephone	—	—	Westinghouse Elec.	102	104
Western Tel. & Tel....	—	—	Westinghouse Elec. pfd.	—	104½

PHILADELPHIA.

	Oct. 7.	Oct. 14.		Oct. 7.	Oct. 14.
American Railways	52½	—	Phila. Traction	98	98
Elec. Storage Battery..	—	—	Phila. Electric	8⅜	8 11/16
Elec. Storage Bat'y pfd.	—	—	Pa. Elec. Vehicle.....	—	1
Elec. Co. of America..	9½	9¾	Pa. Elec. Vehicle pfd..	—	—

CHICAGO.

	Oct. 7.	Oct. 14.		Oct. 7.	Oct. 14.
Central Union Tel.....	—	—	National Carbon pfd....	100¾	99
Chicago Edison	—	—	Northwest Elev. com ..	36	—
Chicago City Ry.	212	210	Union Traction	17	17
Chicago Tel. Co.....	—	—	Union Traction pfd....	50	49
National Carbon	30	31⅛*			

* Asked.

SAN FRANCISCO TROLLEYS.—The firm of Talbot J. Taylor has issued a circular letter treating of the affairs of the United Railways Investment Company, of San Francisco, whose shares have just been officially listed on the Stock Exchange. "Stocks of good street railways," say Messrs. Taylor & Co., "are now a favorite investment. The earnings show steady increases, as they are dependent only upon the growth of population and wealth, which in a young and industrious community are certain to take place. Especial reasons for believing that San Francisco street car system will be highly prosperous at the present time are as follows: The consolidation just effected will bring about a saving in the proportion of operating expense to receipts. The immediate substitution of electric cars for cable and horse cars on those portions of the system where it will be advantageous will result in great additional saving. The refunding of the outstanding 5 per cent. and 6 per cent. bonds with the general mortgage 4s, which will be begun immediately will result at once in a saving of $65,000 per annum, when completely effected in a saving in fixed charges of $215,410 per annum. The introduction of oil as fuel in San Francisco has cut the fuel bill of all manufactures and power plants situated there in half. While this is a tremendous saving in itself for the San Francisco street car system, it is unimportant as compared with the indirect effects which will come from the fact that no city in the world will show in the next two years, and for many years to come, such rapid increase in population and wealth, and consequently such great increase in the gross receipts of the street car system."

CONNECTICUT TROLLEYS.—The Worcester and Connecticut Eastern Railway has sold $2,050,000 4½ per cent. first mortgage sinking fund gold bonds to Thompson, Tenney & Crawford. The total issue authorized is $3,100,000, of this amount $1,050,000 is held in escrow to be issue for improvements and additions, construction and acquisition of connecting railways. The Worcester and Connecticut Eastern Railway owns what was formerly known as the Peoples Tramway Company, the Thompson Tramway Company and the Danielson & Norwich Street Railway Company, and will control through leases the Worcester and Webster Street Railway and the Webster and Dudley Street Railway. The total mileage will be about 55 miles and will operate between Worcester, Mass., and Moosup, Conn., with a branch line to Foster Center, at which point connections will be made with the electric road to Providence, R. I. It is the purpose of the company to build a branch to Bayville, Attawaugan, Ballouville and Pineville, and also to extend the main line of the road from Moosup to Norwich, Conn. The railway owns a valuable hydraulic plant of 2,000 hp on the Quinebaug River, two miles south of Danielson, and eventually this plant will generate sufficient current to operate its entire system. In addition to this, there is located at Oxford a 1,200 hp steam and electric plant, which will be used as an auxiliary plant when necessary. The following are the directors: H. H. Porter, Jr., Chas. F. Brooker, Geo. J. Brush, Edwin Milner, F. S. Curtis, H. M. Kochersperger, Fred. A. Jacobs, E. D. Robbins and E. N. Sanderson.

DIVIDENDS.—The Cincinnati, Newport and Covington Light and Traction directors recently declared a dividend for the quarter of 1 per cent. This was a disappointment to stockholders, who had expected a payment at the rate of 4½ per cent. for the year. One of the officials of the company, however, stated that only 1 per cent. was declared in order to do away with the small fractional dividend, and that in all probability 1¼ per cent. would be declared three months hence. The directors of Milwaukee Electric Railway and Light Company have declared the regular quarterly dividend of 1½ per cent. on the preferred, payable November 1. The United Traction Company, of Albany, N. Y., have declared the regular quarterly dividend of 1¼ per cent., payable November 1. The net earnings for the quarter ended September 30 were $91,299, whereas the dividend requirements for a quarter amount to only $62,500.

ELECTRICS IN ATLANTA, GA.—The Boston Stock Exchange has listed $18,000 preferred 5 per cent. non-cumulative shares and 50,000 common shares par $100, of the Georgia Railway and Electric Company. This company is a consolidation of the Atlanta Railway and Power Company, Atlanta Rapid Transit Company, Georgia Electric Light Company and the Atlanta Steam Company. It controls all the street railway and electric lighting facilities in Atlanta and suburbs, and furnishes all of the municipal lighting. The balance sheet shows a bonded debt of $7,850,000 and a profit and loss surplus of $114,917.

NORTHERN OHIO TRACTION REORGANIZATION.—Official announcement is made of the reorganization plan of the Northern Ohio Traction Company. The new company is to be incorporated with $7,500,000 capital stock and the same amount in bonds. The present preferred stockholders will receive in exchange for their stock a 5 per cent. 30-year gold bond and 100 per cent. of the new stock. The common stockholders will receive one-half in 4 per cent. 30-year gold bonds and 200 per cent. of the same stock as is given to the preferred holders, there being but one kind of stock.

THE AUGUSTA TROLLEY DEAL.—The new company which, as announced in last issue, has absorbed various electric railway and other properties in this city, has applied for a charter. It will have a capital of $800,000 preferred and $4,000,000 common stock. There will also be an issue of $3,000,000 bonds, $2,000,000 of which will be used to retire outstanding bonds, and $1,000,000 will be set aside for improvements and extensions at the command of the trustees. The Railways and Light Company of America has been employed to operate these combined interests by the purchasing syndicate.

LONG TROLLEY LINE.—Cleveland, Ohio, reports that a new syndicate has incorporated the Ohio and Pennsylvania Traction Company, which may be capitalized at $2,000,000, and plans another trolley line from that city to Pittsburg.

Commercial Intelligence.

THE WEEK IN TRADE.—The coal strike and the growing scarcity and need of anthracite is the thought uppermost in the minds of the people in the East at the present time. Every effort to bring about a settlement of the differences between the miners and the operators has failed, but the opinion seems to prevail that the end of the strike must be near at hand. This belief, however, may be based only on the hope of getting a supply of coal before the real cold weather sets in. Uncertainty as to the future supply of fuel is widely noted by the mercantile agencies, and it is pointed out that the scarcity of coke at the West—this being entirely distinct from the anthracite shortage, and due to car shortages complained of throughout the entire year—is displacing some industrial workers in the iron trade. Aside from the fuel scarcity, a satisfactory business prospect exists. Fall jobbing is better than anticipated. Recorders note difficulty of fulfilment, indicating lack of depressing stocks. Spring trade advices are better than usual at this date and predictions as to the coming holiday business are optimistic. The curtailment of the iron production resulted in a smaller output for September than for previous months, but of late the domestic output of pig has shown signs of increasing. Rails, plates and structural iron are active, strong and sold ahead heavily into 1903. Other industries are active, and the east and west movement of freight, swelled by larger grain receipts and heavy buying by the West at the East is proving profitable to the railroads. General activity is reported from the Northwest with improving retail trade, and from the Pacific Coast a generally good business is reported. Export trade is large there, and building activity is exceptional. Southern trade advices are, on the whole, rather good. The railway gross earnings for the month of September were exceptionally favorable; the ratio of gain shown for the month was the best returned since April of this year. The copper market remains quiet; buyers and sellers stand apart awaiting developments. Consumption, it is said, is not as good as heretofore. The closing prices are 11½ @ 11¾c. for Lake, 11.40 @ 11.50c. for electrolytic, 11.37 @ 11.50c. for casting stock. The business failures for the week ending October 9, as reported by *Bradstreet's*, number 170, as against 164 the week previous, and 183 the same week last year.

SOME C. & C. FOREIGN AND DOMESTIC ORDERS.—The C. & C. Electric Company, 141 Liberty Street New York, has just secured a contract for a complete lighting and power plant, which is to be installed in the Mexican mines of the Mexico Commercial Company, of Baltimore, Md. The plant will consist of a 40-hp horizontal engine, direct connected to a 25-kw generator; switchboard, arc lamps, wiring installation, etc. The company, report says, has receipts within the past few days of a number of orders for generators, motors, etc., for the domestic trade. The Rogers Locomotive Works, at Paterson, N. J., are to be furnished with a 150-hp belted generator for power purposes. In addition to the 30 odd machines previously reported for installation in R. H. Macy & Company's new store, at Thirty-fifth Street and Broadway, New York, a 30-hp motor for driving glass cutting machinery and a smaller vertical motor for operating a package distributing table have been ordered. The Chicago City Railway Company, of Chicago, Ill., has requisitioned for four 35-hp and three 25-hp motors, which are intended to be utilized for driving blowers and exhausters. The American Machine and Foundry Company, of Brooklyn, has ordered a complete 40-kw installation, including switchboard. Keasbey & Mattison, of Ambler, Pa., has contracted for three 30-hp motors. The Standard Steel Works, of Burnham, Pa., are to be furnished with one 50-hp and one 30-hp motor, making over 400 hp in motors supplied them during the last few weeks. A 75-kw generator switchboard, etc., has been ordered for a chemical plant in Mississippi. A complete equipment for an electric crane, consisting of three motors, is to be supplied the American Sanitary Company, of Bayway, N. J. Two 75-kw generators, engines, equalizers, etc., have been ordered for a new apartment house, to be built in New York by Wm. C. Dewey. Six 20-hp motors have been ordered by the Standard Plunger Elevator Company, to be used for operating drills for making holes in their elevator plungers at the Bellevue Stratford Hotel, Philadelphia. Another order just to hand calls for a 25-kw direct-connected generator for the Southern Indiana Railway Company, of Bedford, Ind.

THE ALLIANCE MACHINE COMPANY, Alliance, Ohio, organized some months ago for the manufacture of electric traveling cranes and other heavy work of similar class, is completing its large plant there, and will soon be in a position to take care of orders for the heaviest types of cranes. Among others, the company has on its books the following orders: Worth Brothers Company, one 50-ton and four 10-ton cranes; Bethlehem Steel Company, one 100-ton crane; Colorado Fuel and Iron Company, two 25-ton, two 50-ton, three 15-ton, two 20-ton and three 10-ton cranes; Union Steel Company, five 10-ton, three 5-ton and one 10-skull-cracker cranes; Pittsburg Valve and Foundry Company, two 15-ton, four motor cranes; Carnegie Steel Company, one 10-ton, three motor crane; Alabama Steel and Wire Company, two 15-ton four motor cranes; and American Steel and Wire Company, one 15-ton crane. In addition to these orders the company will build two large traveling tables for the Carnegie Steel Company, and twelve rod-reeling machines for the Colorado Fuel and Iron Company.

H. M. SALMONY, 95 Mortimer Street, London, W., England, is desirous of representing abroad American manufacturers who are seeking to introduce their specialties in an effective way at a comparatively small cost. It is Mr. Salmony's idea to visit the best districts of England, France, Belgium, Holland, Norway, Sweden, Germany, Spain, Italy, Switzerland, Austria-Hungary, Russia, Turkey, etc., and while doing so to make with his manufacturers' samples an American electrical trading exhibition. He also proposes to circularize the local buyers and to advertise such visits and the names of the concerns represented. Mr. Salmony proposes to do this on a commission basis, supplemented by an annual contribution towards expenses. This gentleman is well known in America, and speaks most of the European languages fluently, being thoroughly familiar with the Continent. He invites communication, therefore, in regard to this project, and states that before undertaking it he will again visit America in order to acquaint himself with the goods and the parties who manufacture them.

THE ALBERGER CONDENSER COMPANY, of 95 Liberty Street, New York, reports the following among important orders recently received for high vacuum condensing apparatus: Belt Light and Power Company, Pennsylvania Sugar Refinery, Sharon Steel Company, Port Huron Light and Power Company, Hartford Street Railway Company, Binghamton Light, Heat and Power Company. The equipment for the above plants consists of Alberger barometric or surface condensers with improved vacuum and circulating pumps and the necessary appurtenances for producing the high vacuum required by the use of steam turbines which are being installed in most of the above plants.

BALL ENGINE CONTRACTS.—The Osborn Water and Light Company, Osborn O., has recently purchased an additional unit from the Ball Engine Company, Erie, Pa. The Vose Piano Company, Boston, Mass., purchased recently a direct-connected unit, consisting of a Westinghouse generator, direct connected to a Ball engine. The Grand Crossing Tack Company, Chicago, has put in operation a direct-connected outfit, consisting of a Crocker-Wheeler generator, direct connected to a 175-hp engine, built by the Ball Engine Company.

A NEW YORK HOTEL.—Long Acre Square, New York, is to have a $750,000 apartment hotel, upon which work has been begun on the plot at Forty-third Street. Henry B. Mulliken and Edgar J. Moeller are the architects of the structure, which is to be twelve stories high and of the French Renaissance type. The building will have its own heating and lighting plants. Among the features of construction is an electric fountain, which is to be directly beneath the skylight which lights the dining room.

THE ILLINOIS CAR AND EQUIPMENT COMPANY, of Hegewisch, Illinois, just outside of Chicago, has recently purchased a large amount of electrical apparatus which will be used for the operation of wood turning machinery. An order on the Westinghouse Electric and Manufacturing Company includes two 250-kw and one 200-kw two-phase alternators, together with a four-panel switchboard and the following induction motors: two 100-hp, five 75-hp and one 50-hp.

EQUIPMENT FOR TWIN CITY POWER STATION.—The Twin City Rapid Transit Company, of Minneapolis, is now letting contracts for the equipment of its new power station. The boilers will be Babcock & Wilcox. The contract for the coal and ash handling machinery has been awarded to John A. Mead & Company, of Bowling Green Building, New York. The machinery will have a capacity for handling 70 tons per hour, and will cost about $35,000.

MOTORS FOR GRAIN ELEVATOR.—The Steel Storage and Elevator Construction Company has adopted electric power distribution for a large grain elevator which will be erected for the Canadian Pacific Railway at Fort William, Ont. A recent purchase from the Westinghouse Electric and Manufacturing Company includes a direct-current generator and a number of direct-current motors for the operation of this elevator.

THE BROWNING ENGINEERING COMPANY of Cleveland, Ohio, has recently purchased from the Westinghouse Electric and Manufacturing Company a large number of railway-type crane motors ranging in capacity from 25 to 50 hp.

CONTRACT FOR STREET SIGNS.—The New York Edison Company has secured the contract to furnish and maintain blue glass electric sign boxes in Manhattan for $12.50 a year each, and stencil signs for $10 a year.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended October 11: Antwerp—13 pkgs. material, $1,177; 2 pkgs. machinery, $350. British West Indies—206 pkgs. material, $3,194; 100 pkgs. machinery, $21,997. British Possessions in Africa—5 pkgs. machinery, $778; 86 pkgs. material, $1,254. Berlin—2 pkgs. material, $175. British Australia—272 pkgs. machinery, $10,165; 62 pkgs. material, $2,498. Brazil—1 pkg. machinery, $60. Bradford—3 pkgs. machinery, $175. British Guiana—10 pkgs. machinery, $1,890; 14 pkgs. material, $285. British East Indies—20 pkgs. material, $415. Central America—21 pkgs. material, $306. Colchester—4 pkgs. material, $542. Cuba—126 pkgs. material, $3,225. Chili—10 pkgs. material, $149. Copenhagen—6 pkgs. machinery, $1,633. Dutch West Indies—3 pkgs. material, $54. Frankfort—1 pkg. machinery, $120. Glasgow—140 pkgs. material, $2,156. Hamburg—30 pkgs. material, $4,287. Havre—84 pkgs. material, $2,682. Hayti—3 pkgs. material, $20. Liverpool—160 pkgs. machinery, $10,470; 23 pkgs. material, $767. London—33 pkgs. machinery, $3,505; 130 pkgs. material, $6,716. Mexico—24 pkgs. material, $1,846; 18 pkgs. machinery, $670. Portuguese Possessions in Africa—16 pkgs. material, $1,185. Patrar—6 pkgs. material, $150. Peru—12 pkgs. material, $697; 12 pkgs. machinery, $600. Santo Domingo—71 pkgs. material, $552. Southampton—110 pkgs. material, $8,052. Stockholm—3 pkgs. material, $572; 1 pkg. machinery, $150. U. S. Colombia—9 pkgs. material, $163. Venezuela—8 pkgs. material, $215.

PELTON WATER WHEELS.—The Pelton Water Wheel Company reports having just closed a contract with the Vancouver Power Company, of Vancouver, B. C., covering three Pelton wheel units, with a combined capacity of 10,000 hp. The wheels are for direct connection to electric generators; the power to be used for electric railway and manufacturing purposes in the vicinity of Vancouver. The Pelton Company has under construction at the present time Pelton water wheels aggregating 30,000 hp, all of which are to be used in connection with electric transmission of power. The wheels will have a capacity of 3,200 hp each. They will be direct connected to generators, to be built by the General Electric Company. There are also to be two exciter units of 200 hp each. The head will be 390 feet. The Pelton people have also secured a contract for an extension of the plant of the San Rafael Paper Company, Mexico. A mile of steel-rivetted pipe, varying from 28 inches to 32 inches in diameter, will be built. A 600-hp water wheel has also been ordered.

BIG PRODUCER GAS PLANT.—Mr. F. W. Snow, president of the Ramapo Iron Works, Hilburn, N. Y., is about to build the largest producer gas plant hitherto constructed in this country. Considerable electrical equipment will be installed. The plant will serve as a central electric lighting plant for a radius of some 25 miles within Hilburn, and will also furnish energy for large manufacturing plants in the vicinity. The plant will also supply gas for lighting, heating and foundry work to nearby shops. Westinghouse, Church, Kerr & Company have been allotted the contract for the engines which will represent a total capacity of 1,215 hp. There will be three direct-acting gas engines of 350 hp each and a 125-hp engine, also a 40-hp one. The generators will be supplied by the Westinghouse Electric and Manufacturing Company. There will be three 225-kw alternating-current machines and one 75-kw; also a 22½-kw machine for direct connection to the smaller engines. The plant will be operated by producer gas, as manufactured by the process controlled by the Loomis-Pettibone Company, of 52 Broadway, New York.

HYDRO-ELECTRIC DEVELOPMENT IN MEXICO.—The great Passasiachic Falls, situated near Ocampo, in the State of Chihuahua, Mexico, have been purchased by Manuel Siqueros, a capitalist of Juarez, Mexico, and Manuel Gameros, a prominent mining engineer of Chihuahua. They have organized a company to utilize the power derived from these falls for the generation of electricity, to furnish power for an extensive railway system and for a number of mills and mines of that section. These falls are situated in the midst of one of the richest and most extensive mining sections of Mexico. The water has a sheer drop of 1,800 feet over a precipice, and it will not be a difficult engineering task to utilize this power for generating an abundance of electricity for all the requirements of that region. The company proposes to build an electric railway for handling ore, etc., between the town of Minica, at the terminus of the Chihuahua and Pacific Railway and the mining camps of Altos, Ocampo, Pinos and Concheno.

MONTEREY ELECTRIC TRACTION.—Important contracts will be let shortly for the equipment of an electric traction system in the city of Monterey, Mexico. The American Engineering and Contracting firm of Macklin & Dillon, of Monterey, have, as already noted in these pages, been granted a concession to build an electric road of about five miles in length. It is intended also to convert two of the principal existing horse-car roads in the Mexican city, which in all are about 12 miles long. The new electric traction system will, therefore, be about 17 miles in length, and is estimated to entail an expenditure of about $1,000,000. The banking house of Sperry, Jones & Company, of Baltimore, Md., is financing the enterprise. Mr. A. W. McLimont, president of the Federal Electric Company, Washington Life Building, has been retained as consulting engineer by the American interests. He is now on his way to Monterey.

EUROPEAN EQUIPMENT FOR TOKIO ROAD.—The 100 car trucks and equipments for the Tokio Street Railway Company, which have been ordered from Frazar & Company, of Japan, 63-65 Wall Street, will be built by Dick, Kerr & Company, Limited. The contract has been allotted in England, because of considerably better prices and more favorable terms of delivery obtained on the other side. For similar reasons, the contract for the rails, though secured in the first instance through an export house of large American interests—the China and Japan Trading Company, Limited, 32 Burling Slip, New York, will be executed in European mills. There will be about 20 miles of rails. The contract for the poles and special track work has been allotted to the Japanese house of Okura & Company, which concern has an office in the Bowling Green Building, 11 Broadway, under the management of M. Yamadax.

ELECTRICAL EXPORTS.—The U. S. Treasury returns for August show a good condition of electrical exports. The export of electrical instruments for the month was only $262,231, while in August, 1901, it was $451,120; but for the eight months of this year it was $2,388,119, as compared with $689,923. It is evident that the downward fluctuation last August was but accidental and temporary. The export of electrical machinery for August, 1902, was $558,826, as compared with $457,275, and for the eight months this year, $3,896,547, as compared with $3,919,574 last year and $3,590,419 in 1901. The total export of electrical apparatus and appliances therefore this year is $6,284,661, or at the rate of over $750,000 per month for the eight months, or $9,000,000 roundly for the year. This shows that the trade can be sustained and built up.

THE LOCKE INSULATOR MANUFACTURING COMPANY has taken over the business of Mr. Fred. M. Locke, and is now doing business with a capital stock of $150,000, of which $125,000 has been subscribed for and sold. The remaining $25,000 will be issued and sold, as needed, under and by order of the board of directors. The officers of the new company are as follows: Fred. M. Locke, president; Henry M. Parmele, vice-president; Willis D. Newton, secretary; M. W. Burke, treasurer. The directors are the above and C. P. Brown, Chas. H. Fairchild and W. A. Higinbotham. The new company starts out with very bright prospects, the Locke insulators being very widely and favorably known.

THE STOREY MOTOR AND ELECTRIC COMPANY.—A great deal of interest has been aroused in the electrical field in New York City by the announcement of the news that Mr. Henry E. Fanshawe has been elected a director of the Storey Motor and Electric Company, Harrison, N. J., and that he takes his place on the board this week. This gentleman is one of the most aggressive and progressive men in the development of electrical industries, and has a wide circle of friends and acquaintances. Should he take an active part in the management, which presumably will be the case, the Storey motor is likely to become far better known than is already the case, but certainly not beyond its deserts.

MOTORS FOR FRANCE.—The Goudey-McLean Company, of 88 Maiden Lane, N. Y., which concern represents the export interests of several American manufacturing concerns of electrical machinery, supplies, etc., has recently secured contracts for 17 motors from its French office—the Goudey-McLean Company, of New York, 17 Rue de Turenne, Paris. These machines are intended for machine-shop use. The American Electrical Syndicate, of Amsterdam, which is the Holland agency for the Goudey-McLean Company, has just sent in a substantial requisition for a general line of electrical material.

MOTORS FOR MEXICAN LIGHTING PLANTS.—The New England Motor Company, of Lowell, Mass., has secured a contract through the Federal Electric Company of 141 Broadway, for several direct-current generators, varying from 33 hp to 2 hp, for shipment to Mexico for lighting use.

TO PURCHASE FOR BIG BRITISH CONCERN.—The Morris Electric end of the recently formed American Union Electric Company, of 15 Cortlandt Street, it is reported, will act as American purchasing agent for the British Electric Traction Company, Limited, of London.

ELECTRICALLY-DRIVEN SOUTHERN CEMENT PLANT.—The Southern States Portland Cement Company, of Atlanta, Ga., is about to construct a large plant at Rockmart, for the manufacture of cement. All the machinery will be operated by electricity.

General News.

THE TELEPHONE.

CARROLLTON, ILL.—The Rockbridge Telephone Company is now ready for business, and will proceed at once to build about forty miles of line in the eastern part of the county.

SPRINGFIELD, ILL.—Party lines are to be abandoned by the Central Union Telephone Company in Springfield. Persons whose party line telephones are taken out and independent lines substituted in all probability will be called upon to pay the regular rental for independent service.

CHICAGO, ILL.—Two tunnels under the river have just been finished by the Illinois Telephone and Telegraph Company, one at Harrison Street and one at Wells Street, thus giving connection with the Union and Northwestern railway depots. They are six feet wide and seven and one-half feet high, the same size as those under the downtown streets.

LEBANON, IND.—The Lebanon Telephone Company has increased its capital stock from $5,000 to $30,000.

DELPHI, IND.—The Carroll Telephone Company, with principal exchange in this city, has decided to reconstruct its entire plant, the improvements to cost $20,000.

MUNCIE, IND.—The Kinloch Long Distance Company, of Missouri, was licensed to do business in Indiana. Its capital is $30,000. The Indiana headquarters will be at Muncie.

PETERSBURG, IND.—The difficulty between the labor unions of this city and the Cumberland Telephone Company has been adjusted, the company agreeing to employ only home union men.

SOUTH BEND, IND.—The South Bend Home Telephone Company, owned largely by Ft. Wayne capitalists, has given a mortgage on its new plant here for $400,000. The company will make a number of extensions and otherwise improve its service.

TERRE HAUTE, IND.—The Citizens' Telephone Company has now in active use in the city of Terre Haute 1,312 telephones and orders are received daily for more. The numbers begin with 1 and run to 1,312 consecutively.

INDIANAPOLIS, IND.—The new branch exchange of the New Telephone Company began its service a few days ago, and is serving 1,200 patrons; it has a capacity for 3,000 however. The new exchange is located in a new three-story brick building and is equipped with all the modern improvements.

GREENSBURG, IND.—The Independent Telephone Company, of Decatur County, which had its origin two years ago, is claimed by its directorate to be one of the best systems in the country. Beginning with 1,352 miles of wire and 200 subscribers, the lines have been extended all over the county and 956 telephones are now in use. Of these 53 per cent. are in farm residences and villages. The remainder are in the city of Greensburg. The company has long distance connections with surrounding towns and with Indianapolis. The apparatus is of the Stromberg-Carlson Company. On the country lines, three or four telephones are put on one line, but in the city the lines are individual. For local service the company charges stockholders 80 cents and $1.50 a month for residences and business houses respectively. The rates to non-stockholders are $1.25 and $2 a month, respectively.

DOWS, IA.—The West Morgan Telephone Company has been incorporated with a capital of $5,000.

DAVENPORT, IA.—The Independent Telephone Company will build a line to Milan to connect with the rural exchanges.

DALLAS, IA.—The Marion County Farmers' Mutual Telephone Company has been incorporated, with a capital of $15,000, by Ed. Wagner, R. Kerr, R. A. Mullen and others.

BURLINGTON, IA.—The Burlington & Augusta Telephone Company, of Burlington, has been incorporated with a capital stock of $5,000. The officers are E. W. Romkey, president; Henry Magel, vice-president; Nils C. Hansen, secretary and treasurer.

ABILENE, KAN.—The Brown Telephone Company, of Abilene, has been chartered with a capital of $50,000.

HENRYVILLE, KY.—The Cumberland Telephone Company has purchased the People's Union Telephone Company of this place. The latter concern has one hundred subscribers.

LOUISVILLE, KY.—It is expected that by November 1 the long distance connection of the Home Telephone Company will be completed to Owensboro, Henderson, Bowling Green, Lexington, Ashland, Evansville, Huntington and French Lick. Connection will also be established with Indianapolis, Ind.

BRISTOL, MASS.—The Farmers' Mutual Telephone Company has been incorporated at this place with a capital of $10,000. A. M. Round is president and A. H. Sweet, treasurer.

GRAND RAPIDS, MICH.—The Citizen's Telephone Company has obtained control of the system of the Missaukee County Telephone Company, including exchanges at Cadillac and McBain, and 60 miles of toll lines.

GRAND RAPIDS, MICH.—This city is now connected with Toledo by an independent telephone line through the exchange of the Citizens' Company. This connection also opens an important field of toll line connections in Ohio.

MINNEAPOLIS, MINN.—The Minnesota Mutual Telephone and Telegraph Company, of Minneapolis, has been incorporated; capital stock $300,000, of which $20,000 is represented in Wisconsin.

ST. PAUL, MINN.—The Howard Lake Telephone Company, of Howard Lake, Wright County, Minn., has filed articles of incorporation. The capital stock is $50,000 and the incorporators are John A. Peterson, O. J. Olson, John L. Munson, J. W. Custer and Nels Monson, of Stockholm; A. G. Custer, W. H. Eddy and P. E. Eddy, of Victor; H. A. Workman and G. A. Koenig, of Howard Lake.

HANNIBAL, MO.—The Bluff City Telephone Company, of Hannibal, has been incorporated by C. H. Brown, B. E. Hixon, V. T. Strong and others. Capital $100,000.

JEFFERSON CITY, MO.—The Jefferson City Telephone Exchange was purchased Oct. 2 by Messrs. Lester S. Parker, Houck McHenry and A. M. Hough. The exchange was owned by the Capital Telephone Company, of this city, and was considered an excellent plant, being newly installed. The purchasers announce that there will be no change in rates.

PHELPS, N. Y.—The Inter-Ocean Telephone and Telegraph Company has been granted franchises in this place and Avon.

EASTON, N. Y.—The Easton and South Cambridge Telephone Company was organized and started business last month. It is now operating 8 miles of line and 16 telephones, and will probably extend its lines. The officers are F. O. Ives, president; Elias Borden, secretary, and Edward Skiff, treasurer.

CHATHAM, N. Y.—The Chatham Co-operative Telephone Company, of Chatham, has been incorporated to build and operate telephone lines in Columbia County. The capital stock is $1,000, and the directors are Perry G. Babcock, Augustus N. Van Deusen, Norman Ashley and Elizabeth B. Gibbons, all of Chatham.

MEDINA, N. Y.—The Orleans County Rural Telephone Company is making rapid progress in extending its lines in and about Lyndonville. The company proposes to extend its line several miles along the lake road, leading west from Kuckville. The officers are; President, Walter Tuttle, of Lyndonville; vice-president, Kenneth Hedley, of Yates; secretary and treasurer, S. A. Coe, of Yates.

ROCHESTER, N. Y.—The Interlake Telephone Company has been incorporated with a capital of $100,000. The company will operate through Ontario, Wayne, Seneca, Yates, Cayuga, Onondaga, Oswego, Tompkins, Schuyler, Livingston, Steuben, Wyoming, Genesee, Orleans, Allegany and Monroe Counties. The directors are George R. Fuller, Albrecht Vogt, Jacob Gerling, H. Wheeler Davis, William S. Hall, Ezra M. Higgins and Joseph W. Taylor.

CHARLOTTE, N. C.—The Washington & Aurora Telephone Company has been incorporated with a capital stock of $25,000.

BAINBRIDGE, OHIO.—The Bainbridge Telephone Company will build lines in Aurora township.

AKRON, OHIO.—The Akron People's Telephone Company is establishing an exchange in the neighboring village of Warwick.

CADIZ, OHIO.—The Harrison County Telephone Company is establishing an exchange at Scio. A good list of subscribers has been secured.

WELLSBURG, OHIO.—Negotiations are pending for the sale of a controlling interest in the Wellsburg Telephone Company to outside capitalists.

EAST TOLEDO, OHIO.—The Toledo Home Telephone Company is rapidly connecting up its subscribers in East Toledo. The company has secured about 600 subscribers on this side of the river.

CINCINNATI, OHIO.—The Cincinnati Telephone Company has placed upon the market 3465 shares of treasury stock for the purpose of securing money for needed extensions and betterments of the service.

KENTON, OHIO.—The grocers' association has decided to use but one telephone. The rates of both companies are the same, but the Kenton Telephone Company has about twice as many subscribers as the Bell Company.

NEWARK, OHIO.—The Newark Independent Telephone Company has leased new quarters and a new central energy board will be installed. Work will be pushed and it is expected the new system will be in operation by Dec. 1.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company has inaugurated a fire drill for the employees of its exchange. Recently the ninety young ladies of the morning shift descended by the fire escape from the eighth floor of the building in six minutes from the first tap of the alarm gong.

CLEVELAND, OHIO.—Four injunctions have been granted restraining the City Trust Company, of Buffalo, N. Y., from delivering 10,313 shares of the stock of the Consolidated Telephone Company to B. G. Hubbell, president of the company. The petitioners are large holders of the stock and their holdings are now deposited with the City Trust Company, of Buffalo. It is claimed that Mr. Hubbell is about to take possession of the stock and that he has no right to do so.

NORWALK, OHIO.—The Local Telephone Company, which has absorbed the exchanges at Norwalk, Milan, Berlin Heights, Chicago Junction, Plymouth, Greenwich, Attica, New Washington, New London and several smaller towns in this section, is offering to investors $15,000 of six per cent. non-taxable cumulative preferred stock, a part of an authorized issue of $150,000. The company's profits for the ensuing year are estimated at $18,000, or more than double the amount required to pay dividends on the preferred stock.

NASHVILLE, TENN.—The Cumberland Telephone Company desires to cooperate with the city in establishing a conduit system in the streets of this place.

GLOUCESTER COURT HOUSE, VA.—Mr. A. W. Withers has been elected president of the Tidewater Telephone Company. The company will make some extensions.

PETERSBURG, VA.—The Petersburg Telephone Company has been incorporated. The capital stock will be between $50,000 and $100,000. Mr. Wm. B. McIllwaine is president.

RICHMOND, VA.—The Southern Bell Telephone Company is gradually acquiring local companies by securing a controlling interest in their stock and will finally take them over as part of its own system. The Hampton Telephone Company, at Hampton, Va., and the Mutual Telephone Company, of Petersburg are recent acquisitions.

MILWAUKEE, WIS.—An advance in the toll rate of the Wisconsin Telephone Company has gone into effect. The general toll tariff for the State is re-adjusted on a two-minute instead of a three-minute basis, as the initial period, as heretofore. The one-minute business has been found unprofitable, but an arrangement will be made whereby the demand for it can be met.

ELECTRIC LIGHT AND POWER.

DOVER, DEL.—The Urban Heating and Electric Company, of Wilmington, has been incorporated, with a capital stock of $100,000, by G. W. Kimball, W. L. Missimer and L. L. Shockley, all of Wilmington.

BRUNSWICK, GA.—The Mutual Light & Water Company has applied for incorporation, the purpose for which the company was organized being to purchase, construct and equip electric lighting and power systems, and carry on a system of water works in the city of Brunswick. The new company has taken over the plant of the Brunswick Electrical Supply Company. The petitioners are A. B. Coley, of Brooklyn, N. Y., George A. Prentiss and C. M. Acklen, of Elliott City, Md., E. H. Mason, E. Brobston and E. Fendig.

WAUKEGAN, ILL.—Plans are under consideration for the erection at Waukegan of a $300,000 electric power plant for Samuel Insull and Frank Baker, of Chicago, to supply electricity to all towns along the north shore from Waukegan to Evanston and the Waukegan and Fox Lake Electric Railway.

MARION, IND.—The Marion Light and Heating Company has purchased ground upon which to build a large heating and lighting plant.

INDIANAPOLIS, IND.—The Bristol Power Company, of Elkhart, has filed articles of incorporation with the Secretary of State. The company will construct a dam across St. Joseph river, build a power house, generate and furnish electric light and power to all the towns and cities of Elkhart and St. Joseph Counties. The capital stock is $500,000. Directors: E. A. Sanders, Joseph Dusham, M. V. Beeger, H. H. Porter, Francis Bosson and W. G. Gasbett.

JERSEY CITY, N. J.—The Municipal Light and Power Company, capital $2,000, has been incorporated by William C. Sherwood, Richard F. Tully, and H. A. Bingham.

PRINCETON, N. J.—The Princeton Electric Light Company, the Princeton Gas Company and the Hopewell Electric Light, Heat & Power Company have been purchased by local capitalists and will be merged into a single company to be known as the Princeton Lighting Company. The new company will be capitalized at about $500,000. It has contracts now to supply six or seven towns surrounding Princeton with light, and is going to lay out between $50,000 and $75,000 on an addition to its plant at Rocky Hill.

ELMIRA, N. Y.—The Chemung County Gas Company, Elmira, has been incorporated to supply gas and electricity to Elmira Heights, Horseheads and other places; capital, $500,000. Directors: Denman Blanchard, North Andover, Mass.; Andrew J. Miller, New York; M. H. Arnot, Elmira.

SYRACUSE, N. Y.—At the annual meeting of the Syracuse Lighting Company it was announced that $500,000 would be spent in new buildings and equipment, and the capacity of the plant be doubled. The following directors were elected: Robert C. Pruyn, of Albany, Stephen Peabody, James C. Bishop and Frederick Strauss, of New York; Howard L. Clark, Providence; Charles Andrews, Horace White, Hendrick S. Holden, Ceylon H. Lewis, Albert K. Hiscock, John Dunfee, John J. Cummins and Louis L. Waters, Syracuse. The board of directors elected the following officers: President, Ceylon H. Lewis; vice-president and treasurer, John J. Cummins.

WILLISTON, N. D.—There is an opening for an electric light plant in this place. Mr. L. H. Dow may be addressed on the subject.

AKRON, OHIO.—The city council has approved the new contract with the Northern Ohio Traction Company for furnishing electric light to the city. The contract is an extension of the old lighting franchise.

NORTH BALTIMORE, OHIO.—Dr. Henry has secured a ten year franchise for electric lighting with a contract from the village for 40 arc lamps at $70 per year. For many years the town has been paying $85 per lamp.

LORAIN, OHIO.—The Citizen's Gas & Electric Company has increased its capital stock from $150,000 to $600,000. The company will acquire the gas and electric lighting plants at Elyria and Lorain and the merger will take place within a few days.

CINCINNATI, OHIO.—Through the burning out of some of the main feed wires in the underground system of the Cincinnati Edison Electric Light Company recently, the entire city was left in darkness and many places of business were without power until repairs could be made. The theaters were forced to close and newspapers were obliged to set type by hand.

CINCINNATI, OHIO.—The Miami & Erie Canal Transportation Company will commence the operation of its electric boats between Cincinnati and Dayton before November 1. The company has arranged with the Cincinnati Traction Company for power, pending the completion of the company's own power houses. It is stated that the company has applications for shipments amounting to over 800,000 tons per annum, sufficient to keep between fifty and sixty boats busy.

PITTSBURG, PA.—It is stated that all of the new coaches to be built by the Pennsylvania Railroad Company for its main line service will be equipped with electric lights and storage batteries. Many of the old coaches have been sent to the shops to be wired for the electric lighting system. The construction of an electrical plant at Allegheny has been authorized, and two or three others will be built at division points on the lines west. A plant has just been completed at Cleveland.

HARRISBURG, PA.—The following named electric light companies have been chartered here recently: The Dorranceton Electric Light Company, Dorranceton, Luzerne County; capital, $1,000. The Courtdale Light, Heat & Power Company, Courtdale, Luzerne County; capital, $1,000. The Kingston Township Light Company, Kingston, Luzerne County; capital, $1,000. The Luzerne Electric Light Company, Luzerne, Luzerne County; capital, $1,000. The Plymouth Electric Light, Heat & Power Company, Plymouth, Luzerne County; capital, $1,000. The Kingston Light, Heat & Power Company, Kingston, Luzerne County; capital, $1,000. The Dorranceton Light Company, Dorranceton, Luzerne County; capital, $500. The Hillside Light Company, Kingston Township, Luzerne County; capital, $5,000. The Plymouth Township Light Company, Luzerne County; capital, $500.

NEWPORT, R. I.—Alfred Gwynne Vanderbilt has installed a large electric light and power plant at Oakland Farm, his summer home at Portsmouth. He has built a brick power house about a hundred yards from his residence and set up a 16-hp single cylinder kerosene engine. By use of a storage battery the dynamo will be run only during the late afternoon and evening.

MEMPHIS, TENN.—The Memphis Electric Light & Power Company and the Equitable Gas Company have been merged.

CHATTANOOGA, TENN.—The Tennessee Coal, Iron & Railroad Company is making preparations for the erection of a large electric power plant for the lighting and operation of its mines at Ensley, Ala.

COVINGTON, TENN.—Arrangements have been perfected for closing the sale of the Covington electric light plant to the city, the price being $11,650. An expert electrician has been engaged to overhaul the entire system. The lines will be extended and the plant improved generally.

PALESTINE, TEX.—Messrs. Hunter and Taylor, of Greensboro, N. C., have received an option on the Palestine electric plant, which is good until January. They propose to buy the plant, enlarge and extend it, and put in electric street railway system.

SEATTLE, WASH.—The building of a municipal plant is being discussed, the power to be received at 40,000 or 50,000 volts from a generating point 35 miles out of the city.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The Fresno Inter-Mountain Railroad Company, which was recently incorporated in California, has Fresno as its principal place of business. The directors are S. N. Griffith, L. L. Gray, G. I. Helm, G. M. Taft and M. Wallace. The capital stock is $500,000.

ELKHART, IND.—The $40,000 necessary to secure the Elkhart, Winona, Warsaw & South Bend Electric line has been obtained and work will begin at once.

JASPER, IND.—A corps of civil engineers has completed the survey for an electric railway from this place to Mitchell by way of French Lick and West Baden. This line is likely to form a link of the Indianapolis and Louisville trunk line.

LAPORTE, IND.—The Chicago & South Shore Railway Company has completed and opened its line from this city to the Chautauqua Grounds on the north shore of Pine Lake. The company is pushing the work on the Michigan City division.

WABASH, IND.—The Wabash-Logansport Traction Company, in order to get a level and straight line between this city and Logansport will lay a new track on the north side of the river between this city and Peru. The present circuitous route on the south side of the river will be used as a local line while the new route will be employed for fast through service.

WINCHESTER, IND.—The Union City, Winchester & Muncie Traction Company, of Winchester, has filed articles of incorporation. This company filed articles last July, but surrendered the charter obtained then and received a new one. The capital stock is placed at $275,000. Joseph E. Lowes, of Dayton, Ohio, is president and John E. Feight, of Dayton, Ohio, secretary. Theodore Shockney, of Union City, is the principal Indiana man connected with the company.

EVANSVILLE, IND.—The Evansville & Princeton Traction Company has closed a contract with the Westinghouse Company for $72,000 worth of electrical equipment for its power house and road. The contract calls for two 400-kw generators for the power house, two 300-kw rotary converters, two substation equipments, switchboards, etc., and for each of the ten cars four 55-hp motors. The company has filed a mortgage in favor of the Chicago Title & Trust Company to secure $400,000 of bonds issued by the company.

FRANKFORT, IND.—At a meeting held in this city Sept. 26 by capitalists of Chicago and Aurora, Ill., Lafayette and this city, steps were taken for the organization of a company to build a system of interurban lines with this city as the center. The plan is to build a line from Kokomo to Lafayette and from this city to Logansport with an ultimate outlet to Chicago. The capitalists present were R. S. Vivan and W. D. Ball, of Chicago, Wm. George, Charles Karoley and V. A. Watkins, of Aurora, O. V. Darby, of Kokomo, and D. A. Coveter, of this city. This company will incorporate in a few days.

DETROIT, MICH.—The Windsor Street Railway Company has commenced surveys for its extension to Ojibwa and Amherstburg. This road was purchased some time ago by the Detroit United Railways.

ST. LOUIS, MO.—The stockholders of the St. Louis & Suburban Railway have voted to increase the capital stock from $3,000,000 to $7,500,000. The indebtedness was increased by the issue of bonds to the amount of $7,500,000. Of the new bonds, $2,300,000 will be reserved for the purpose of retiring bonds of the company to the same amount, being all its bonds now outstanding, and to insure the payment of them.

NEW YORK, N. Y.—Electric trains are now in regular operation on the Sixth Avenue elevated line. The steam trains have not been entirely discontinued, however. The process of substitution will take place gradually. The Second and Third Avenue lines have been in full electric operation for many months. The Ninth Avenue line is being prepared for electric power.

NEW YORK, N. Y.—It is reported that George Gould is a prominent figure in the plan to merge the New Jersey trolley systems having Newark as the center. The roads which are to be merged are the White Line, running from Hoboken to Paterson and Singac; the Elizabeth and Plainfield and the North-Jersey Traction Company's system, operating in Jersey City, Bayonne, Newark, Elizabeth, the Oranges, Montclair, Caldwell, Verona, Irvington, Hilton, Maplewood, Belleville, Franklin, Passaic, Arlington, Harrison and Kearny.

STONEVILLE, N. C.—A project is on foot to build a trolley line between Stoneville and Spray, N. C., the power to be supplied by an electric plant at Spray.

MARIETTA, OHIO.—Stockholders of the Greencastle, Waynesburg & Mercersburg Turnpike Company are considering the building of a traction line along the turnpike from Greencastle to Marietta.

TOLEDO, OHIO.—It is stated that the Toledo, Bowling Green & Southern Traction Company has secured a private right of way from Bend to Dunbridge and into Toledo. Heretofore the company has operated into Toledo from Perrysburg over the tracks of the Toledo & Maumee Valley Railway, but it is now proposed to build its own line into Toledo.

PORTLAND, ORE.—The City and Suburban Railway Company of Portland is enlarging its power plant at Inman, Poulsen & Co.'s sawmill. A large Babcock tubular boiler has been delivered on the ground and will be set up at once. For the new generator and engine the excavation has already been completed and this portion of the plant will be installed at once on concrete foundations. The improvements will give an addition of about 500-hp. This will be needed for the operation of the St. John line which is now being fitted with electrical apparatus throughout its entire length, and for several other extensions.

THE AUTOMOBILE.

AUTOMOBILE MANUFACTURERS.—At a meeting of the executive committee of the National Association of Automobile Manufacturers, Mr. H. Ward Leonard, formerly third vice-president, was elected first vice-president to succeed A. L. Riker; Frederic Martin Lande, formerly secretary, was elected second vice-president, succeeding Dane E. Aianhard; Charles Clifton was made third vice-president; Harry Unwin, formerly assistant secretary, was made secretary, and Windsor T. White was elected to the executive committee. The members have generally signified their intention of adopting the standard form. In addition to trying to standardize the number of spke and lug holes for single-tube tire rims and the rim sections for double-tube tires, the association proposes to bring about the adoption of a standard section for solid tires.

NEW INDUSTRIAL COMPANIES.

THE ROSSMAN ELECTRIC CO., ot Jersey City, N. J., has been incorporated; capital, $2,000. Incorporators: Frederic P. Warfield, Geo. McHawley and Thos. McEwan, Jr.

THE NATIONAL TROLLEY MANUFACTURING COMPANY has been incorporated at Rochester, N. Y., capital $100,000. Directors: Stephen Rauber, Robert Seibert and R. T. Ford, of Rochester.

THE CRESCENT ELECTRIC COMPANY has just been formed at Evansville, Ind. J. B. Greene is the general manager. The company proposes to do a general contracting, construction and electrical supply business.

THE WESTERN MOTOR COMPANY, of Logansport, Ind., has incorporated with $400,000 capital stock. The company has purchased a plant and will manufacture automobiles, electric and other motors and do a general foundry business. Robert Parker, Edwin Rutember and E. H. Wolcot are directors.

THE ELECTRIC MILK COMPANY, of Schenectady, N. Y., has been incorporated. Capital $10,000. The directors are J. O. Carr and Rob't H. Fraser, of Schenectady; William T. Ford and William W. Zelie, of Cohoes; Le Grand Rexford and William A. Graves, of Rexford Flats, and George H. Smith, of Visscher's Ferry.

THE STANDARD TECHNICAL CO., of New York, has been incorporated to manufacture electrical machinery. The capital stock is $2,000. The directors are L. Sweet, H. L. Case and W. V. Goldberg, New York.

G. H. WALBRIDGE & CO., have been organized in Morristown, N. J., to manufacture electrical apparatus. The capital stock is $400,000, and the directors are G. H. Walbridge, E. B. Bruckman and G. M. Broks, of New York.

THE ELKHART FROG AND CROSSING WORKS COMPANY, Elkhart, Ind., has been incorporated. The capital stock is $30,000. The company will manufacture railroad frogs, switches and crossings and other appliances for steam and electric railways. J. W. Fuldhoun, F. A. Reed, John Wiley and H. A. Jevat are directors.

THE UNITED STATES CONSTRUCTION COMPANY has been incorporated at Toledo, Ohio, by Louis H. Gound, J. P. Degnan, Charles Komrofoky, Sherman Bond and John Haley for the purpose of constructing electric railways, lighting plants and telephone lines. Capital stock, $1,000. This company is doing the construction work for the Toledo, Columbus, Springfield & Cincinnati Railway of this city.

OBITUARY.

MR. FRED BATHURST, well known to a large circle of electrical engineers and others in this country, died in England, Sept. 26, of heart failure, resulting from asthma, to which latter disease he had been subject for some years. Mr. Bathurst was a pupil of Prof. Ayrton at the City Guild's Institution, at Finsbury, upon leaving which he joined the staff of Woodhouse & Rawson. Coming to this country shortly afterwards, he connected himself with the Edison General Electric Company, remaining when this was merged into the General Electric Company. About seven years ago Mr. Bathurst returned to Great Britain to introduce there the conduit system of interior wiring. In papers before electrical bodies, contributions to the columns of the electrical press and otherwise he constantly urged the merits of the system, with the result that they came to be generally recognized in Great Britain. A few years ago he was awarded a gold medal and £25 offered by the Society of Arts for a paper on the prevention of fire risks. The genial disposition of Mr. Bathurst made for him hosts of friends in this country, who will keenly feel his loss.

PERSONAL.

MR. N. F. BRADY, treasurer of the New York Edison Company, has just returned home after a very interesting and enjoyable European trip, lasting a couple of months.

MR. CLARENCE MACKAY arrived in New York last week on his way from San Francisco to Europe. His father is now understood to have left an estate of about $80,000,000.

MR. T. W. MILLER, treasurer of the Goudey-McLean Company, of 88 Maiden Lane, New York, is now in Europe for the purpose of visiting several of the agencies of the company.

MR. E. D. ADAMS, the banker, prominently identified with the development of Niagara power and other great enterprises, has just returned from Europe on the Kronprinz Wilhelm.

MR. A. A. BLISS, treasurer and general manager of the New England Motor Company of Lowell, Mass., was in New York this week en route for Norfolk, Va., on a Southern business trip.

MR PAUL J. KREUSI, of the Sunlight Lava Mfg. Co., Chattanooga, Tenn., has been visiting the north on a holiday, looking up trade connections and making plans for future development of the business.

MR. L. W. STANTON, superintendent of equipment of the Federal Telephone Company, of Cleveland, Ohio, has been a visitor to the Atlantic seaboard, in connection with independent telephone work.

MR. E. D. BLACKWELL, of the Neshobe Electric Company, Brandon, Vt., has been visiting New York and studying up the latest ideas and wrinkles in wiring, for the benefit of the customers of that lighting system.

MR. PHILIP DAWSON, M. I. E. E., has become a partner in the consulting engineering firm of Kincaid, Waller & Manville, whose practice will be carried on at 20 Great George Street, Westminster, London.

MR. LEONARD BIGOT, of Buenos Ayres, is now in the United States for the purpose of placing contracts for considerable electrical equipment, including cranes, etc. He may be found at the Export Club, Tontine Building, 82-88 Wall Street.

MR. F. L. HUTCHINSON, the advertising and agency manager of the Christensen Engineering Company of Milwaukee, Wis., has been visiting the East in the interest of the new generators and motors now being put on the market by that progressive concern.

MR. GEORGE F. PORTER, until recently the secretary of the National Electric Light Association, has just received from that body a superb set of engrossed resolutions illuminated on vellum, testifying to his good work in the ten years during which he held the office.

MR. SEYMOUR FOLWELL, who was formerly manager of the offices recently closed in New York of the British electrical engineering and contracting firm of Robert W. Blackwell & Company, Limited, is now with the Cutter Electrical and Manufacturing Company, of Philadelphia.

PROF. R. A. FESSENDEN has, we are informed, resigned his position with the government, in which he was engaged in the development of wireless telegraphy, in order to conduct experiments with his wireless telegraph system. Experimental stations will be established in the neighborhood of Norfolk, Va.

MR. W. M. MORDEY, the well-known English electrical engineer, and his partner, Mr. Dawbarn, have been appointed consulting engineers for a lighting and trolley scheme for the city of Johannesburg, South Africa, and about 100 square miles of the Rand country. Both gentlemen are visiting the Transvaal in connection with this work.

MR. L. B. STILLWELL enjoys the well-deserved compliment of occupying the first page of *Harper's Weekly* of October 11, as one of the Americans of to-morrow. But we like neither the portrait nor the skimpy biographical sketch that accompanies it. As in Mr. Vreeland's case, the portrait is a distinct failure, as showing the mental calibre of the man.

MR. H. F. PARSHALL, the electrical engineer, before he left for London, presented to some of his more intimate friends here copies of a photograph of himself riding a camel in the vicinity of the Sphinx and the Great Pyramid, which keep each other company in the Egyptian desert. Mr. Parshall visited the Nile region this year for some professional work.

MR. JAMES P. GILBERT, who has been the general superintendent of the New York and Ohio Company, Warren, Ohio, manufacturers of Packard lamps and transformers, has resigned his position, and will take the general management of the Standard Electrical Manufacturing Company, at Niles, Ohio, manufacturers of the Standard incandescent lamp.

MR. HARDIN H. LITTELL, the veteran street railway manager of Buffalo, N. Y., has accepted the presidency of the Springfield & Central Illinois Railway Company, organized to take over the Springfield Consolidated Street Railways and suburban lines. Mr. Littell was president of the Louisville City Railway for many years and afterwards had charge of the Buffalo lines after reorganization.

MR. W. J. HAMMER returned to New York, October 6, from a four-months' visit to Europe, during which he made a study of the latest electrical and engineering developments, visiting for this purpose England, Norway, Sweden, Denmark, France, Italy, Switzerland and Belgium. While in Italy Mr. Hammer spent several days inspecting the Valtellina three-phase railway.

Over forty miles of the road was in operation and all of those connected with the railway expressed great satisfaction at the efficient manner in which the road operated.

EDUCATIONAL.

STREET RAILWAY ENGINEERING COURSE.—Mention has been made previously in these columns of the excellent practical work being done in both day and night courses at Lewis Institute, Chicago. It has recently been announced that, beginning Oct. 7, a course will be given with classes two nights per week in street railway engineering practice. This course will take up different types of construction and equipment and costs. H. M. Wheeler, of the Engineering Department of the Chicago Union Traction Company, is the instructor, and the course promises to be one of much practical benefit and engineering excellence.

POPULAR SCIENCE LECTURES.—Dr. H. Leipziger, on behalf of the New York Board of Education, is beginning his regular winter course of lectures in the public schools. In several centers electricity will form the subject of a course. Thus, Theodore I. Jones will deliver a course in public school No. 3, Grove and Hudson Streets. In Institute Hall, No. 218 East 106th Street, W. W. Ker, teacher of physics in the Hebrew Technical Institute, will give a course on the same subject; also in the Young Men's Institute, No. 222 Bowery, Prof. E. R. von Nardroff, teacher of physics at Erasmus Hall High School, Brooklyn, will give eleven lectures on physics and electricity in the Young Men's Hebrew Association Hall, 92nd Street and Lexington Avenue, and in St. Bartholomew's Lyceum Hall, No 205 East 42nd Street. Prof. W. C. Peckham, of Adelphi College, will give four lectures in public school No. 3 on "Chemistry and its Relations to Electricity."

Trade Notes.

CONDUIT CONTRACT AWARD.—Mr. G. M. Gest, the conduit contractor, has been awarded the contract for all the underground conduit work to be installed by the Brooklyn Heights Railroad Company this season. This contract amounts to over $25,000.

WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently taken the agency for the new Nernst lamp. It states that it is carrying a complete line of these in stock, and is prepared to ship promptly from St. Louis stock any size or voltage.

THE NOXEM TELEPHONE RECEIVER, which has been put upon the market by the telephone department of the Electric Appliance Company, Chicago, is having a large sale among the telephone companies and manufacturers. Circulars giving full description and prices are now being distributed.

STERLING LAMPS.—The spiral filament found in the Sterling Special incandescent lamp is proving more than an interesting topic of conversation. The value of this filament lies, it is said, in its giving a full 16-c. p. from the tip of the lamp. Mr. William Coale, treasurer of the Sterling Electrical Mfg. Co., Warren, Ohio, was a recent New York visitor.

FORT WAYNE BULLETINS.—The Fort Wayne Electric Works, Fort Wayne, Ind., in their bulletins Nos. 1025, 1030 and 1032 describe and illustrate, respectively, direct-current belted generators, single-phase generators and direct-current belted motors. The bulletins are of the standard form, and give tables of dimensions of the machines, besides illustrations of details and completed machines.

THE BULLOCK ELECTRIC COMPANY is planning a large addition to its plant at Norwood, Ohio. At the present time the company has under construction a building 300x177 feet, but the addition planned for will be 900x177 feet. It will be erected south of the present plant and will be of one story, of brick and steel construction. The company is preparing to build electrical machinery of the largest sizes.

THE PELTON WATER WHEEL COMPANY recently issued one of the handsomest catalogues ever produced on the subject of water wheels. This catalogue is handsomely illustrated with half-tone engravings, showing various parts and styles of Pelton wheels. It also contains colored half-tones of interesting scenes connected with the company's hydro-electrical work, etc. It is a most interesting and useful publication.

BALL ENGINES.—Among recent sales by the Ball Engine Company, Erie, Pa., have been engines to the Blaine Coal Company, Lock No. 2, Pittsburg, which has recently installed an electrical service; to the American Tobacco Company, Allen & Ginter Branch, Richmond, Va., for direct connection to a Crocker-Wheeler generator; and to the Athens Cotton Oil Company, Athens, Tex., a 125-hp engine to run an electric plant.

ELECTRIC COOKING.—The Simplex Electric Heating Company, Cambridgeport, Mass., in a little pamphlet, gives a good deal of interesting information about electric cooking. The advantages of this method of cooking are clearly pointed out and the features of the various utensils manufactured by this company are also described. This pamphlet is an interesting discussion on this subject and will well repay a careful reading.

DE REMER WATER WHEEL.—This water wheel which is used in many hydraulic plants in the West is illustrated and described in a pamphlet of the Mine and Smelter Supply Company, Denver, Col. The design of the bucket used in this wheel is claimed to be a new development in hydraulics, and the bucket has been classed as a tangential impact. Various statements are made in support of the claims for superiority of construction and design.

RENOLD SILENT DRIVING CHAIN.—The principle of design and construction of the Renold high speed silent driving chain is clearly illustrated and described by the Link-Belt Engineering Company, Nicetown, Philadelphia, in a neat little pamphlet just issued. All interested and power transmission will find in its 32 pages matter of lively concern to them. This system of transmission was fully described and illustrated in ELECTRICAL WORLD AND ENGINEER of Jan. 18 last.

THE ELECTRIC STORAGE BATTERY COMPANY has just finished the installation of a storage battery plant at Oakland Farm, the summer home of Alfred Gwynne Vanderbilt, near Portsmouth, Va. The installation consists of a Hornsby-Akroyd 16-hp kerosene engine belted to a Westinghouse direct-current generator capable of furnishing current for 150 16-c.p. lamps. The storage battery consists of 63 chloride cells capable of furnishing 63 amperes over a period of eight hours.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, states that the demand for its new type Peerless incandescent lamps is greater than ever. It states that the factory has recently doubled its capacity, in order to take care of the enormous output. It is now making some very attractive prices on this lamp. It says that the reduction in price has nothing to do with the quality of the lamp, as it is making better lamps to-day than ever before. It has a very attractive little booklet which gives more detailed information about incandescent lamps in general, and Peerless in particular, which will be mailed upon application.

THE WARD LEONARD ELECTRIC CO. has recently filled a large number of orders for its banks of interlocking theatre dimmers. During one week in August, orders were received for 16 banks of interlocking dimmers, many of which were from theatres which are improving their existing lighting effects. Among the dimmers supplied were the following: Three banks for the Princess Theatre, Melbourne, Australia; one bank aggregating 1,300 lights for a large theatre in the City of Mexico; dimmers for the Lyceum Theatre, Detroit, Metropolitan Opera House, St. Paul, Bijou Theatre, Harlem Music Hall and West End Theatre, of New York City. It has also recently supplied several large banks of dimmers for use in English theatres.

THE CHINNOCK ELECTRIC EQUIPMENT CO., 39 Cortlandt St., New York, has secured the contract for installing the switchboard and motors, including the electric wiring for the Merchants' Refrigerating Co., Jersey City. This plant is one of the largest refrigerating plants in the world. There are 11 Otis elevators to be installed, including the isolated plant which will consist of two 100-kw generators and 13 motors. The contract for elevators has been awarded to the Otis Elevator Company. The contractors for this plant are Messrs. V. J. Hedden & Son. The same company has received the contract for installing the power transmission plant for the new factory of the Tuttle & Bailey Mfg. Company, Brooklyn, for installing 17 motors. These motors are from 5 to 30 horsepower. The contract for the equipment, including generators, motors, etc., is now in operation.

NEW YORK TRADE SCHOOL.—A course of ten lectures for journeymen electrical workers will be given during the coming winter season by the New York Trade School, First Avenue, 67th Street, New York. The dates and subjects of these lectures are as follows: October 31, Units of Electricity; November 14, Electrical Currents; November 28, Electric Light Wiring; December 12, Electric Motors; December 19, Dynamos and Generators; January 16, 1903, Methods of Testing; January 30, Switchboards, Rheostats and Circuit Breakers; February 13, Storage and Primary Batteries; February 27, Arc Lights, Open and Enclosed; March 13, A Complete Generating Plant. Ten lectures for journeymen steam engineers will also be given at the same institution, one every two weeks, beginning with October 22. The lectures in both branches will be conducted by Mr. Arthur A. Hamerschlag.

CRANE POCKET CATALOGUE.—The Crane Company, Chicago, Ill., has just issued a new edition of its pocket catalogue. This catalogue is of unusual size, containing no less than 464 pages, and is bound in heavy boards. It covers the Crane Company's complete line including standard, medium, low-pressure, extra heavy and hydraulic goods in brass and iron, engineers' supplies, tools, pipe, etc. It is profusely illustrated with views of the various devices manufactured by this company, and at the back contains some tables very useful to engineers and mechanics in general. At the front of the book there are illustrations of the Crane Company's various branch offices, including the home establishment, there being twenty-one in all. This book will no doubt be very valuable to engineers, and a copy of it may be obtained by any one interested by simply addressing the home office or any one of the branch houses.

AIR COMPRESSORS.—An artistically illustrated and otherwise well-gotten-up catalogue of air compressors has just been brought out by the Chicago Pneumatic Tool Company, 95 Liberty Street, New York. These compressors, although designed primarily for the operation of pneumatic tools in shop and field, riveting, drilling, chipping, hoisting, etc., are also suitable for all of the customary employments of compressed air power. The catalogue contains new illustrations of all of the latest types of compressors and a complete description and illustrations of the chief features of design. It also contains all necessary data pertaining to standard styles of compressors; an article on the uses of compressed air and much valuable information relative to the proper installation of compressed air equipment, besides various tables. A copy of the catalogue will be sent free on application to anyone interested in this line of work.

CHARLES H. BESLY & CO. report their general business as very good. The month of September, just closed, was one of the largest in the amount of sales they have ever enjoyed. They are making many shipments of their Gardner grinders to various parts of the country. At this season of the year they are closing many contracts with agricultural people for their celebrated Helmet oil, Badger and Bonanza cups, these having been adopted by the following well-known makers of agricultural machinery: International Harvester Co., McCormick, Plano and Deering Divisions, Avery Mfg. Co., Port Huron Engine & Thresher Co., Sandwich Mfg. Co., Safety Shredder Co., Newark Machine Co., Parsons Band Cutter and Self Feeder Co. and others. They are receiving numerous orders for complete shop equipments, and for tools and supplies for repairs and replenishing. Their new 300-page general catalogue will be mailed free on application.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 7, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

710,414. CONTROLLING DEVICE FOR ELECTRIC GENERATORS; J. H. Bickford, Salem, Mass. App. filed March 19, 1900. The work circuit is supplied by a dynamo or a storage battery; when the battery is being discharged, it is completely in series with the work circuit and when being charged by the dynamo it is in two parts in parallel on the dynamo circuit, sufficient resistance then being in circuit to bring down the voltage to the point for charging.

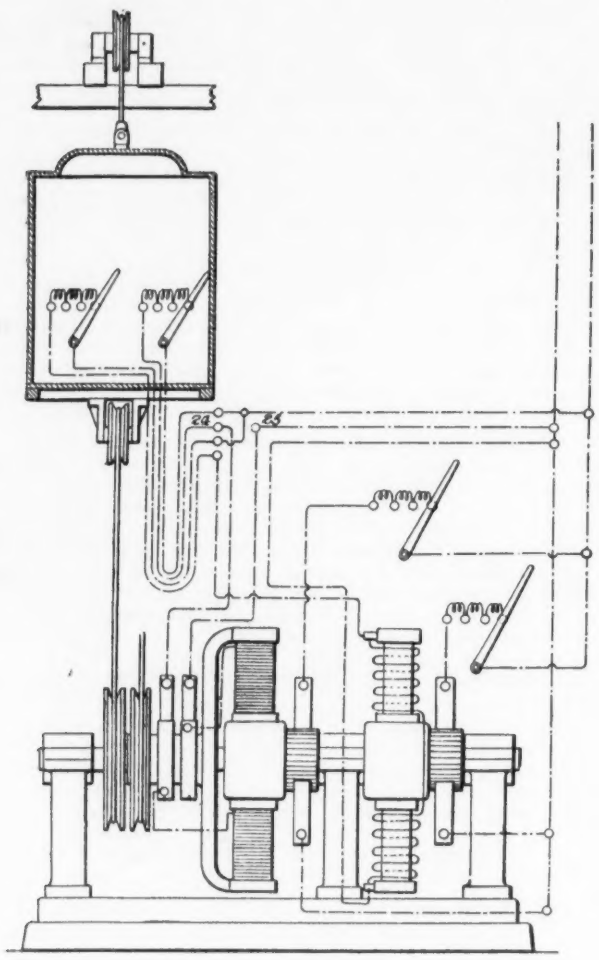
710,425. FRAME FOR DYNAMO ELECTRIC MACHINES; A. J. Churchward, Brooklyn, N. Y. App. filed Sept. 12, 1896. The pole pieces are of such size and shape that they will become magnetically saturated sooner than the cores of the magnets.

710,429. ELECTRIC BODY APPLIANCE; P. J. Collins and C. G. Boland, Scranton, Pa. App. filed Jan. 22, 1902. A number of contact plates arranged in the garments of the wearer, are connected through a little switchboard with a source of current carried at the belt.

710,469. TROLLEY; J. F. Kerr, Paterson, N. J. App. filed Aug. 8, 1901. The wheel is mounted on a crank at the upper end of a vertical oscillating stud.

710,473. ELECTRIC LIGHT SWITCH; H. W. Lawrence, Denver, Colo. App. filed Dec. 28, 1901. Details.

710,488. BUSHING FOR ELECTRICAL CONDUITS; M. Mauer and W. J. Billings, New York, N. Y. App. filed Feb. 17, 1902. The bushing is held in place around the outer end of the conduit by entering an eccentric opening in the wall of the outlet box and being turned to bring engaging shoulders together.



710,625.—Electric Elevator.

710,516. ICE CLEANER FOR TROLLEY WIRES; F. N. Root, Kalamazoo, Mich. App. filed Jan. 23, 1902. Ice-cutting wheels are arranged adjacent to the trolley wheel.

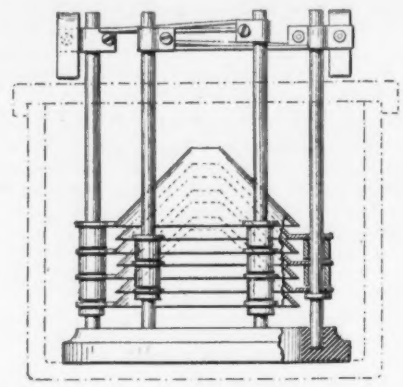
710,532. RAIL BOND; C. Sprague, Boston, Mass. App. filed Feb. 24, 1902. The ends of a laminated bond are dipped in solder and encased in a copper sheath.

710,541. ELECTRIC MOTOR OR GENERATOR; J. A. Titzel, Sr., Franklin, Pa. App. filed Dec. 13, 1900. Detail.

710,581. ELEVATOR; J. D. Ihlder, Yonkers, N. Y. App. filed Jan. 2, 1902. The speed of the elevator is automatically reduced in proportion to the load, before stopping.

710,597. SPEED CONTROLLING GOVERNOR; H. N. Motsinger, Pendleton, Ind. App. filed Feb. 15, 1902. A dynamo is bodily mounted on a pivot and is swung by the action of a centrifugal governor to alter the friction between a pair of friction-driving disks.

710,625. ELECTRIC ELEVATOR; R. C. Smith, Yonkers, N. Y. App. filed July 10, 1899. The armature and field of the motor rotate in opposite directions, their relative speed rates being controlled electrically.



710,870.—Storage Battery.

710,627. MAGNETIC TOY; L. J. Sullivan, Boston, Mass. App. filed Nov. 29, 1901. Permanent magnets are used to rotate an artificial flower and bring into view certain words or phrases.

710,659. GAS CAP FOR ARC LAMPS; E. H. Belden, Dayton, Ohio. App. filed Oct. 7, 1901. Details.

710,667. DEVICE FOR AUTOMATICALLY UNROLLING THE PAPER RIBBON IN MORSE APPARATUS; L. Cerebotani, Munich, Germany. App. filed Nov. 27, 1901. Details.

710,669. ALCOHOLIC LIQUID PURIFIER; C. C. Clark, Philadelphia, Pa. App. filed April 4, 1902. The liquid passes through a chamber containing electrodes, which cause the sediment and solid matters to be deposited.

710,691. MAGNETIC TRACTION WHEEL; B. B. Hill, St. Petersburg, Russia. App. filed Jan. 28, 1902. An iron rim containing a coil can be adjusted to the rim of an ordinary car wheel for the purpose of transforming it into a magnetic traction wheel.

710,716. ELECTRIC MOTOR; G. H. Reynolds, New York, N. Y. App. filed Dec. 5, 1900. A modification of patent No. 710,625.

710,736. CONTROLLER FOR BEER OR OTHER PUMPS; E. S. Baldwin, Peabody, Mass. App. filed July 16, 1900. Details.

710,787. CEILING ROSETTE FOR DROP LIGHTS; C. F. Lewis, New York, N. Y. App. March 28, 1902. The rosette is made to straddle the moulding to avoid cutting the same and the wires are passed continuously over the top of the base and beneath the cap.

710,788. GOVERNOR FOR WATER WHEELS OR OTHER MOTOR DEVICES; L. Lyndon, New York, N. Y. App. filed Oct. 23, 1901. A dynamo driven by the water wheel is automatically controlled by an electromagnetic device.

710,794. RAIL BOND; E. P. Morris, East Orange, N. J. App. filed July 9, 1901. The ends of a flexible bond are passed through and secured in openings in the heads or end pieces.

710,802. ELECTRIC GAS LIGHTER; A. Radiguet, Paris, France. App. filed Feb. 28, 1902. Details.

710,829. ELECTRIC CLOCK; W. F. Winslow, Winsted, Conn. App. filed Oct. 19, 1901. The spring is wound at intervals by an electro magnet.

710,854. MAIL BOX; P. P. I. Fyfe, Concord, N. C. App. filed Sept. 14, 1901. An electric alarm is applied to the letter box to show when mail is placed therein or the box is being tampered with.

710,870. STORAGE BATTERY; H. P. King, Osgood, Ind. App. filed May 16, 1902. The plates are conical in shape and strung upon vertical standards.

710,872. ALARM DEVICE FOR TANKS; M. Kubitzky and R. B. Stewart, New York, N. Y. App. filed Feb. 7, 1902. A float with a metallic top plate closes an alarm circuit when the liquid rises to a certain level.

710,892. STARTING DEVICE FOR ELECTRIC MOTORS; T. M. Pusey, Kennett Square, Pa. App. filed Jan. 8, 1902. The rheostat arm is moved by a clock frame controlled by a solenoid having a high and a low resistance coil in two different circuits, the latter coil tending to neutralize the effect of the former.

710,914. ELECTRIC OPERATION OF ELEVATORS BY SINGLE PUSH BUTTON SYSTEM; J. D. Ihlder, Yonkers, N. Y. App. filed Dec. 6, 1897. Details by means of which a dumb waiter or freight elevator can be called to any floor by the operation of a push button at that floor.

710,933. BATHING TUB FOR DIPOLAR GALVANIC BATHS; J. Zwiebel, Neu-Ulm, Germany. App. filed Dec. 12, 1901. A bath tub or non-conducting material having rods arranged along each side and movable electrodes thereon to be grasped in the hands.